

**SAM 935™**  
**Surveillance and**  
**Measurement System**  
**Version 11**

*Revised: September 2005*

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**Firmware Release 02.11.01**

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# 1. Introduction

The SAM 935™ is a portable gamma spectroscopy system, often called an isotope identifier, which detects and identifies multiple gamma and x-ray nuclides, providing qualitative and quantitative analysis.

The basic SAM 935 unit consists of:

- The spectrometer electronics (controller)
- The internal or external detector
- A rechargeable battery pack (installed in the left side of the instrument)

Optional devices include:

- Quantum software (post process analysis)
- An internal He3 neutron detector (installed along the back edge of the instrument)
- Ethernet adapter
- Earphone adapter
- Tantalum shield (external probe only)
- Upright carrying handle (external probe only)
- Quantum Librarian

The instrument can be operated in a variety of survey modes, each with its own alarm trigger criteria.

The SAM 935 has four different modes of operation:

- Dose Rate, the default mode
- Sigma
- Spectra
- Manual

The instrument is designed to be operated primarily in Dose Rate or Sigma mode. In any of these modes, an alarm (sample acquisition) can be stored, reviewed and qualitatively analyzed in a multi-channel analyzer (MCA). Each stored alarm can be printed or downloaded.

Manual (MCA expert) mode will not allow review of stored alarms, dose-rate measurements, neutron measurements, or many of the SAM 935's built-in time slice features.

The instrument has a simple user interface and a set of powerful setup and database editing functions, most of which are easily accessed through commands in the **Utilities** menu.

The SAM 935 can be connected and operated like an MCA by a remote computer (using an RS-232 serial connector) with Quantum™ software.

The SAM 935 can be operated with a variety of different NaI gamma detector sizes. The instrument will allow for detection and identification of any gamma or x-ray isotope with a peak from 15 KeV to 3 meV with a relative photon intensity of 1% greater.

## 1.1. *How To Use This Manual*

This manual uses the following typographic conventions:

<b>File</b>	Menu names, indicating the SAM 935 screen mode, are shown in bold mixed case.
ENTER, F1...F4	Function key names are shown in small capital letters.
<i>Setup Menu</i>	Menu choices and on-screen prompts are shown in italics.

The SAM 935 includes the following operating modes:

Mode	Description	Section
Dose Rate	The default operating mode. The instrument continuously takes readings and identifies isotopes in real time 1-second snapshots. Readings are displayed in dose rate units, saving and reporting any alarm conditions (conditions where the dose rate exceeds the dose rate trigger).	6.1
Sigma	The display shows a bar graph providing individual isotope identification and strength of source indication based off sigma over background (standard deviations). This mode inherently provides significantly superior detection sensitivity.	6.2
Spectra	The actual spectrum being acquired is displayed in real time 1-second snapshots. If an alarm is in progress, the displayed spectrum represents the accumulated spectrum for the entire alarm. Alarm threshold is based off sigma over background (standard deviations). Use the MCA analysis for identification in this mode.	6.3
Manual (expert mode)	Mode used to acquire data as a conventional multichannel analyzer; view and edit hardware parameters; set, clear and edit ROIs; and perform qualitative analysis. The manual mode will not allow review of stored events, dose-rate measurements, neutron measurements or many of the SAM 935s built-in time slice features.	Appendix
Calibration	Used to "normalize" the energy calibration and/or acquire a new background. It is recommended 5 minutes after power up.	5.2
ID	Automated "One Button" sample acquisition providing the same editing functionality as the Manual mode with the addition that the saved spectrum has dose rate and sigma above background data. This function will generate an MCA analysis report. The acquisition time may be preset by the end user in the range of 6 seconds to 60 minutes.	2.1.2
Search On/Search Off (Srch On)/(Srch Off)	Geiger counter-like clicking sound that increases in frequency as the dose rate changes, and aids the user in finding areas of activity without having to watch the SAM 935 screen.	6.1



## 2. Quick Reference Guide

### Setting Survey Mode

The three modes of real time surveying are: **DoseRate**, **Sigma**, and **Spectra** (the latter two are generally not used for attended monitoring but can be turned on in the Setup menu).

**DoseRate** alarms are triggered by a preset exposure rate (the default is 5 miliREM/hr).

**Sigma** and **Spectra** alarms are triggered by SIGMA (standard deviations) over background.

- The Sigma levels can be edited for each specific source.
- Full = background and any other source that may be present.
- Default triggers for Sigma and Spectra are **full=8**, **unidentified=7**, all other isotopes=5.
- Rule of Thumb: any sigma level =3 or lower is likely a false indication due to natural cosmic radiation.

Real-time surveying offers the end user the ability to identify sources in 1-2 seconds but more importantly tells the user that there is a high probability of a source present so that the <ID> key can be pressed at the opportune time and place. Real time screens by themselves play an important advantage but their degree of accuracy is not high. Therefore, these screens are supposed to be used as a tool for the end user to gauge what isotope may be present, not for the final identification. Isotopes that appear with a question mark next to them are under 20 microREM/hr in intensity and most likely caused by fluctuating background or sources in the background.

You will achieve the best accuracy in identification when you select the <ID/F3> button, which will take a preset timed acquisition. This <ID> acquisition can be adjusted anywhere from 6 seconds to 90 minutes (the default is one minute). During acquisition this time can be incremented by +/- 30-second intervals (F3, F4). Thus acquisition time can be easily adjusted on the fly depending on whether the spectrum statistics are good or poor (representing a strong or weak source).

After the acquisition is complete a multi-channel analyzer (MCA) report will appear on the screen.

Using the arrow keys and noting the scroll bar on the right hand of the screen you can review the entire qualitative analysis report.

Under the subheading **Peaks Found** the report will list all ROIs (Region of interest) that were found in the spectrum.

Some of these ROIs will have an identified nuclide listed to the right and some will not.

Nuclides that appear on an ROI line with a question mark have a higher than normal uncertainty (UNC) percentage. A UNC of 10% or greater will show a question mark next to the source. The next course of action would be to take another acquisition for 30 seconds to a minute longer to achieve better statistics (improved accuracy).

Press F1 to exit the report.

### Real-time Identification

Real-time surveys use only ROI matching when making an identification.

<ID> analysis reports use both ROI and relative photon intensity matching to make a positive identification.

The only sources that will be identified in the real-time mode are those that have been manually entered into the **active** trigger list noted in the upper left hand corner of the screen.

A maximum of 20 isotopes can be entered into each of the three trigger lists A, B, or C.

When a source is entered into a trigger list it will be marked as ENA (enabled) in the master isotope library and incorporated in the MCA analysis qualitative report. If a source does not have an ENA listed to the right in the master library, the source will NOT be included for Qualitative analysis in the MCA report.

You can enable (ENA) sources manually without entering them into a trigger list. In this case the source would show up as unidentified in real-time, but be identified in the MCA analysis report.

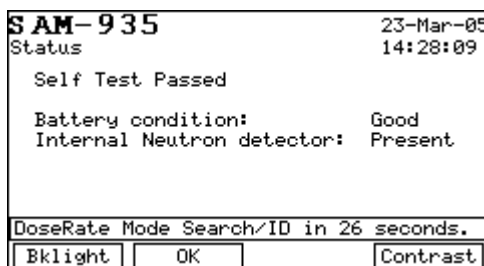
### **Downloading Spectra Using BNC SAUce:**

Connect the SAM to a PC using a **null** modem RS232 cable. Use Start/Program to find and open BNC SAUce on your PC. In the upper left corner of the screen open the COM port. To review stored alarms in the SAM press left arrow. This will review stored alarms starting with the last alarm (right arrow will start with the first alarm). Press F3 (Prn Sel) to transfer the Realtime (DoseRate) reports to the PC. If you press MCA (F4) and ID (F4) it will generate the MCA qualitative analysis report and by pressing F2 (P-Full) or F3 (P-Short) you are able to download. BNC SAUce automatically saves all reports with a time/date name in a Rich Text format, so they can be accessed via a word processing program (like MS Word) if needed.

## **2.1. Powering On the SAM 935**

Power on the SAM 935 using the ON/OFF push button on the control panel on the left back side of the instrument behind the sliding door.

The instrument will automatically begin a self-test, and the status will be indicated in the **SAM-935**, "Self test passed" screen.



There will be a 30 second warm up countdown as the SAM prepares itself for Dose Rate Mode. During the countdown, you can do the following:

- Press the BKLIGHT (F1) function key to turn the backlight on or off.
- Press the OK (F2) function key to start taking readings immediately.
- Press the CONTRAST (F4) function key to open the "Adjust contrast" screen. Use the up, down, left and right arrow keys to adjust the contrast. Press ENTER when done.

There are two calibration procedures: auto-calibration and coarse (manual) calibration. If your unit came with a radiation source then you will have the resources to perform an auto-calibration (temperature stabilization). After 20 seconds you will see a "please wait" message and calibrating percentage and a progress bar letting you know it is in process. There are further details in Utilities under **Calib** submenu. If the instrument is unable to complete auto-calibration, the SAM will prompt you to perform coarse calibration.

Sodium Iodide (NaI) detectors normally stabilize about 5 minutes after the power is turned on, assuming a stable temperature environment.

To start taking readings, see Section 2.1.2 "Taking Readings" on page 6.

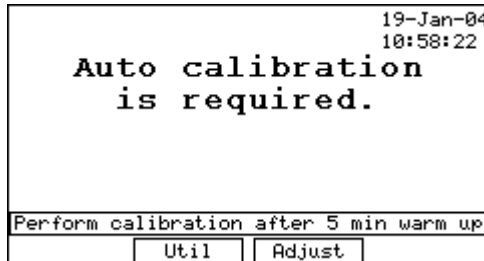
The autocalibration stabilization process uses a tiny Co-60 source permanently attached to your detector. Co-60 has two energy peaks, and occasionally, the algorithm will fail to find the high energy peak because of low count statistics. The system can easily recognize this error, because the correction factor is in the range of -13% to -11.5%, and it will ignore the result and take another measurement instead. If you see this message reported on the screen occasionally, there is no need to worry—the calibration process will soon rediscover the correct peak and return to normal operation.

### 2.1.1. Performing Coarse Calibration and Background Readings

After the self-test has run, you may be prompted to take a calibration and background reading. Until you perform the calibration, the prompt will appear each time you power on the instrument.

The "Auto Calibration is required" screen (below) appears:

- The first time the SAM 935 is powered on after a firmware reset.
- When an important setting has been changed that affects calibration.



The "Auto calibration is required" screen contains two function keys:

- Press the UTIL (F2) function key to enter the **Set Up** menu to adjust the instrument settings.
- Press the CALIB (F3) function key to enter the coarse calibration screen.
- The screen will provide a prompt to give you 60 seconds to find a check source. And then will automatically begin calibration after the 60 seconds has elapsed. You can bypass the 60 second wait period by pressing CALIB (F3) to immediately begin calibration.

To run a calibration and background reading:

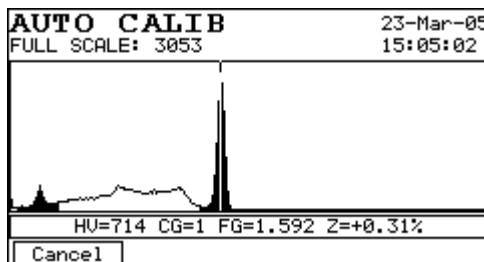
1. Press the CALIB (F3) function key.
2. You will be prompted to place the Cs137 standard on the detector.

---

*Note: If previous changes in operating parameters have left the position of the Cs137 662 peak far enough from its normal position to prevent capture, an "Unable to Adjust" message will appear. If this happens, you will have the option to reset the operating parameters to their factory defaults and try again.*

---

3. Place the check source as close as possible to the *right back* corner of the SAM 935, where the internal detector is located, or, for external detector models, at the detector window. Press the OK (F2) function key to immediately start the coarse adjustment.

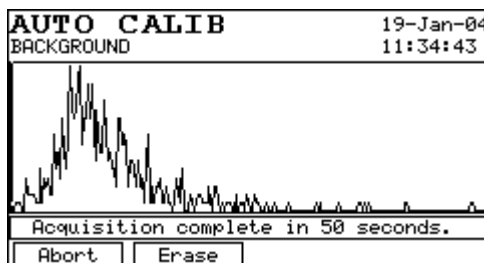


4. After the coarse calibration is complete, the instrument will beep twice.
5. Remove the Cs137 source from the vicinity of the detector.
  - Press the RETURN (F1) function key to begin normal monitoring.
  - Press the BKG (F2) function key to start taking a new background reading.
  - Press the WAIT (F3) function key to restart the 60-second countdown if you need more time to remove the source.

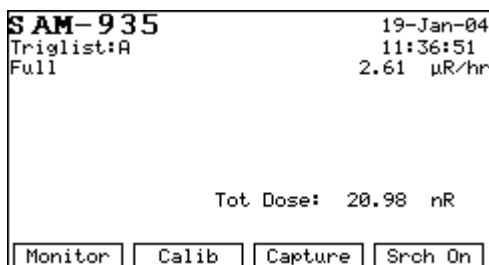
If the SAM 935 detects that the background reading is unusable or non-existent, it will display the following screen. Press the Bkg (F2) function key to start the background acquisition.



6. The automatic background adjustment will take 1 minute (the factory setting). You will see the spectrum build, as shown in the following screen:

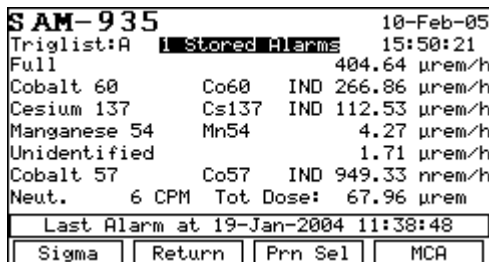


7. Normally, you will only need to perform a coarse adjustment and background reading. The instrument may prompt you to perform a **fine** calibration at this point if:
- The external detector has been changed.
  - The fine calibration has been corrupted, or canceled due to resetting of factory defaults.
  - See Section 5.2.1 for fine calibration procedures.
8. When the calibration adjustments are done, the dose rate monitoring screen, shown below, will appear and you can start taking readings (Section 2.1.2).



## 2.1.2. Taking Readings

The survey screen is shown below in default Dose Rate mode. In this mode, the instrument continuously takes readings and analyzes isotopes in dose rate units (REM), storing and reporting any alarm conditions (defined as conditions where the dose rate exceeds the dose rate trigger).



The survey screen includes four function keys:

- Press the (F1) function key to operate the SAM 935 in a Sigma survey mode which provides sigma above background readings per individual isotope in the trigger list.
- Press the CALIB (F2) function key to open the **Coarse Calib** screen and perform a quick calibration adjustment if needed.
- Press the ID (F3) function key to provide a sample acquisition (capture) for a preset time while remaining in real time survey mode. This has the advantage of providing sequentially numbered alarms that can be reviewed and analyzed using the multi-channel analyzer. Each stored alarm can provide either Dose Rate or Sigma data during review of its corresponding survey screen. Preset capture times from 6 seconds up to 60 minutes can be entered (the default preset time is one minute). A separate menu item (Set ID Capture Time) is located in the Utilities menu for this procedure. These type of alarms will be labeled "Captured."
- While capturing an alarm the user may increase or decrease capture times using the F3 and F4 function keys.
- Press the SRCH OFF/SRCH ON (F4) function key to enable or disable the audible search feature. This will allow the instrument to offer Geiger-Counter-like audible chirps.

To take readings:

1. Hold the SAM 935 in front of you so you can read the display.
2. If you have an *internal* detector, it is installed on the *right side* of the SAM 935. Place the sample as close as possible to the *upper right* corner of the SAM 935. If you have a factory-supplied, *external* detector, take readings by placing the sample as close as possible to the detector window. The optional neutron detector, if installed, is located above the LCD screen inside the controller. The sensitive direction is broadside to the back of the unit.
3. Press the (F1) function key to change survey display modes if others are enabled.
  - SPECTRA will allow you to view one-second readings in real time. This survey screen triggers alarms in the same manner as the Sigma over Background bar graph screen.
  - Press the CALIB (F2) function key to open the **Coarse Calib** screen and perform a quick calibration adjustment if needed.
  - Press the ID (F3) function key to provide a sample acquisition (capture) for a preset time while remaining in real time survey mode. This has the advantage of providing sequentially numbered alarms that can be reviewed and analyzed using the multi-channel analyzer. Each stored alarm can provide either Dose Rate or Sigma data during review of its corresponding survey screen. Preset capture times from 6 seconds up to 60 minutes can be entered (the default preset time is one minute). A separate menu item (Set ID Capture Time) is located in the Utilities menu. These type of alarms will be labeled "Captured."

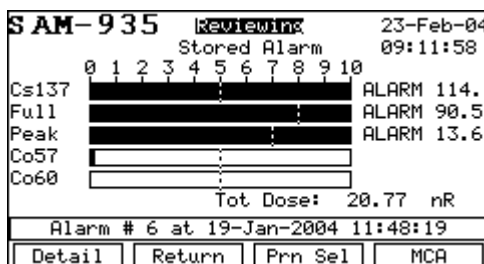
## **2.2.     *Reviewing Alarms***

An alarm condition is triggered when a surveyed item exceeds the trigger level (the Dose Rate or Sigma above background ratio). During an alarm, the SAM 935 acquires and stores an integrated spectrum for the duration of the alarm. The alarm level displayed for each surveyed item is the highest level encountered during any time interval of the alarm. This allows the SAM 935 to detect a transient trigger on one isotope that might otherwise be masked by a longer alarm generated by another isotope.

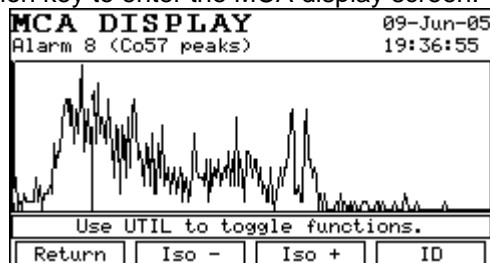
The SAM 935 can store over 250 alarm events. Each stored alarm consists of a spectrum and all the information necessary to analyze it.

#### To review alarms:

1. Use the left arrow key to review the alarms in the order in which they were taken, from the newest to the oldest. Use the right arrow key to review the alarms in reverse order, from the oldest to the newest.



- You will know you are reviewing an alarm when the word "Reviewing" appears in bold at the top center of the screen.
- The alarm number and time and date stamp will appear.
- Press the RETURN (F2) function key at any time to return to the main monitoring screen.
- Press the PRN SEL (F3) function key to print the currently displayed stored alarm in a real time report. (See Section 8.28.2 below.)
- Press the MCA (F4) function key to enter the MCA display screen.



- If ID (F4) key is selected, it will generate a MCA Qualitative Analysis Report.
- F2 or F3 will allow you to toggle through MCA enabled isotopes which provide manual Regions of Interest (ROI) matching.
- Press the F1 function key to change survey display modes if others are enabled.
- Press the RETURN (F2) function key at any time to return to the main monitoring screen.

A "Memory Full" message will appear on screen if the stored alarms approach the memory capacity of 265 alarms. When memory is full, no more alarms will be accepted and a cycling audio alarm will sound.

### **2.3. Powering the SAM 935 Off**

Whenever the SAM 935 is turned off, all information is saved in battery-backed-up RAM, allowing you to restart the instrument without losing calibrations or other information. Note that if the internal nickel metal hydride (NiMH) battery has failed, the self-test display will indicate the problem.

Make sure the SAM 935 is in a normal survey screen mode. Power off the SAM 935 using the ON/OFF push button on the control panel on the left back side of the instrument behind the sliding door.

### 3. Connecting Hardware

The connection ports for the analog power cord and peripheral devices are located on the left back side of the instrument, behind the sliding door.

#### 3.1. *Recharging the Battery Pack and Connecting the Power*

The SAM 935 can run 8 hours total per recharge cycle on the internal battery pack when backlit mode is turned off, 4 hours total with backlit mode on.

It is strongly recommended that you recharge the battery pack when you receive the unit from the factory. During operation, the clock display will be replaced with a *Battery Low* message when the battery pack needs to be recharged or replaced. **Some batteries lose voltage very quickly when approaching full discharge, so the battery low warning may appear only seconds before shutdown.**

To recharge the battery pack:

1. Make sure the SAM 935 is powered off because the batteries will not recharge with the unit on. The power ON/OFF switch is the push button on the left back side of the instrument, next to the power port.
2. Plug the factory-supplied battery wall charger into the power (PWR) port (located below the RS-232 port and next to the power ON/OFF button). **Always use the factory-supplied battery wall charger to ensure that the batteries are not damaged.**
3. Plug the other end of the battery charger into a standard wall outlet. It takes approximately 4 hours to recharge a completely empty battery pack.

You can operate the SAM 935 continuously using the battery charger, but you cannot recharge the internal battery pack while the instrument is powered on. DO NOT connect or disconnect the charger while the SAM 935 is operating or the power will cycle and potentially damage the detector.

#### 3.2. *RS-232 Connections*

SAM 935 RS-232 Connections		
Receive Data	RX	2
Transmit Data	TX	3
No Connection		4
Ground	GND	5
No Connection		6
Request to Send	RTS	7
Clear to Send	CTS	8
Power	UIC	9

#### 3.3. *Connecting an Optional External Detector*

To connect the optional external detector:

- Make sure the SAM 935 is powered off as there is considerable voltage traveling through the LEMO cable to the detector.
- Hold the unit in normal operating position and attach the supplied LEMO connector to the port on the lower right-hand side of the SAM 935.
- Attach the other end of the LEMO connector to the external detector.
- Power on the SAM controller

- Press UTIL button to move to utility menu.
- Scroll down to “Select/Edit Detector” and press ENTER button.
- Select the correct detector size and press ENTER button.
- Press RETURN (F1) to return to previous menu(s).

Note: If you are changing the factory provided detector you will need to re-calibrate the new detector with both a fine and dose rate calibration. (See Section 5.2 below.)

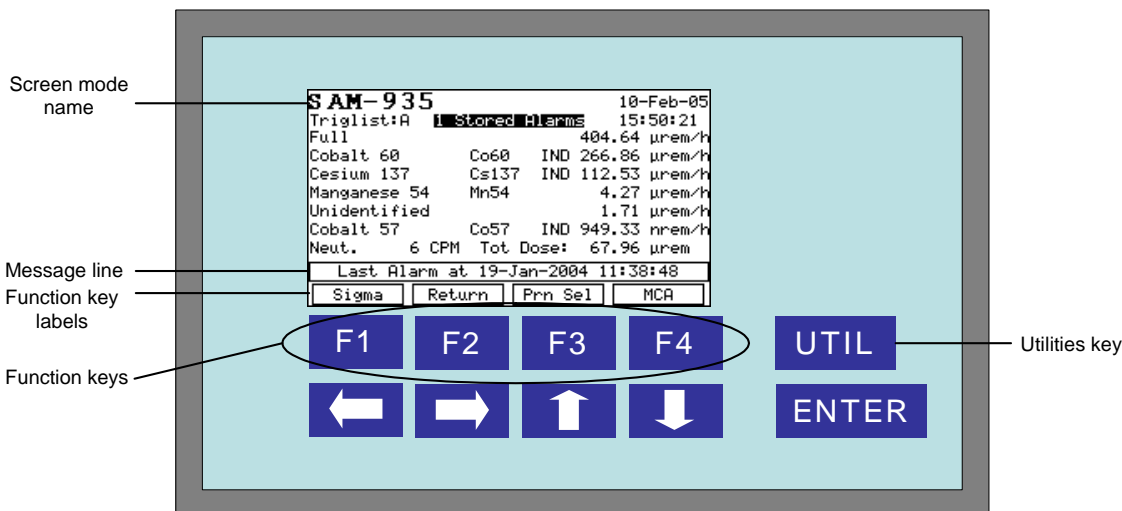


## 4. The SAM 935 User Interface

The SAM 935 has a simple user interface, described in this section. It is recommended that you review this information before using the instrument for the first time.

### 4.1. The Front Panel

The LCD panel on the front of the SAM 935 displays menus, instructions, data and reports. Each screen has a mode name (**SAM 935** in the example screen below).



The message line, directly above the function key labels, displays important information about the current state or mode.

The first row of function keys (F1 through F4) controls different software functions. The current function of each key varies according to the active screen. The function key labels corresponding to each key are displayed directly above the corresponding numbered key.

Some function keys perform a single, defined function. For example, RETURN or exit always appears over F1 when available and is used to exit from the current screen when done. CANCEL is used to abort a step, usually without saving changes.

Other function keys are sometimes used as toggle keys, and are used to activate or deactivate a certain mode (for example, ENABLE becomes DISABLE).

The arrow keys below the function keys are used to select items from lists or move the cursor.

The UTIL function key is used to access the **Utilities** menu.

The ENTER function key is used to make selections and to indicate when certain tasks have been completed.

### 4.2. Scrolling Through Long Menus

Many SAM 935 screens (such as the **Edit Isotope Library** screen, below) contain menus from which you must select an item.

To select an item:

- Use the up and down arrow keys to highlight your choice.
- Press the ENTER function key to select it.

UTILITIES				19-Jan-04
Edit Isotope Library				14:17:39
I123	13.2	H		
I125	60.14	D		
I131	8.04	D		
Tc99m	6.01	H		
Tl201	72.912	H		
Cr51	27.704	D		
SELECT ISOTOPE				
Return Add Delete Edit				

Some lists are too long to be displayed on one screen. You can use any of the following methods to move to the different screens:

- Keep pressing the down arrow key. When you pass the last item on the screen, the display will jump to the next menu screen.
- Use the left or right arrow keys to move to the previous or the following menu screens, respectively.
- Use the scroll bar on the right side of the screen as a guide to know where you are.

### 4.3. *Editing Instructions*

Some SAM 935 screens require text or numerical entries. The keyboard has only 10 keys, so you must follow the specific data entry and editing procedures described in this section. All data entered into the SAM 935 is battery backed up, so normally you will only need to enter or edit specific information once.

When you create new entries, the SAM 935 may automatically enter a default value such as "Name."  
Delete this entry before entering your data.

#### *Editing Text*

An example of text editing is shown in the **Edit Isotope**, "Edit Name" screen. The current text value is highlighted on the screen and must be removed.

<b>Edit Isotope</b>		19-Jan-04
Edit Name		14:21:31
BCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz !"#\$%&'()*+,-./0123456789: Name		
USE ARROWS TO SELECT CHARACTER		
Cancel Select Delete Space		

To edit text:

- Use the arrow keys to select each character, one at a time, from the grid.
- Press the SELECT (F2) function key to add the selected character to the text entry.
- To edit the text in the highlighted field, press:
  - DELETE (F3) to delete a character.
  - SPACE (F4) to enter a blank space.
- Press the ENTER function key to save the entry and move to the next screen. Caution: Press ENTER too early and you must begin all over again.
- Press the CANCEL (F1) function key to cancel the edit without saving the changes. You will be asked to confirm the cancel.

## Editing Numbers

Numerical editing is similar to text editing, but is restricted to the few characters appearing in a floating point number, including exponents.

### To edit numerals:

- To enter a new value:
  - Use the arrow keys to highlight the value in the list at the top of the screen.

19-Jan-04  
11:58:24

1234  
56789  
-+.e

USE ARROWS TO SELECT DIGIT

Cancel Select Back Clear

- Press the SELECT (F2) function key to add the selected character to the numerical entry. Enter values in fixed (xxx.xx) or floating (x.xx $\times$ 10 $\pm$ xx) format.
- Press the BACK (F3) function key to backspace and delete one value at a time.
- Press the CLEAR (F4) function key to delete an entire value in a highlighted field.
- Press the ENTER function key to save the entry and move to the next screen.
- Press the CANCEL (F1) function key to cancel the edit without saving the changes. You will be asked to confirm the cancel.

### To use the arrow keys to edit numerals:

Some screens require you to use the left, right, up and down arrow keys to change a value. Edit one field at a time.

09-Jun-05  
19:19:56

1.000 mrem/hr

Arrows select/change, enter when done

Cancel

- To move to the next character, press the right arrow key.
- To move to the previous character, press the left arrow key.
- To increase the value of the highlighted character, press the up arrow.
- To decrease the value of the highlighted character, press the down arrow.
- If the entered value is higher than the maximum allowed, the value will automatically reset to maximum allowed.

## 5. Reconfiguring the SAM 935 After Using “Reset Factory Defaults”

To set up the SAM 935:

1. Connect the hardware.
2. Power on the SAM 935 and let it self-test and start up.
3. Perform the following recalibration steps:
  - A coarse adjustment.
  - A background spectrum.
  - If using a new detector, a fine energy calibration.
  - If using a new detector, a dose rate calibration.

To complete all three calibration steps, you must have a Cs137 source and an Eu152 source.

You MUST perform a coarse adjustment with Cs137 and a background spectrum:

- When you first install the SAM 935.
- Whenever any noticeable changes in temperature occur.
- When you have cleared all stored spectra and have temperature stabilization turned off.
4. Configure the other system settings using the commands in the **Utilities** menu.

### 5.1. Starting Up the SAM 935

After you connect the hardware, power on the SAM 935 using the ON/OFF push button on the left back side of the instrument behind the sliding door. If you have just performed a *Reset Factory Defaults*, you will be prompted to select a detector before the self-test screen appears. Otherwise, the SAM 935 will automatically perform a self-test before starting up. The set of screens below show examples of possible self-test results.

A successful self-test.

<b>SAM-935</b>		23-Mar-05
Status		14:28:09
Self Test Passed		
Battery condition:	Good	
Internal Neutron detector:	Present	
DoseRate Mode Search/ID in 26 seconds.		
Bklight	OK	Contrast

A self-test indicating a low battery condition.

<b>SAM-935</b>		BATTERY
Status		LOW
Self Test Passed		
Battery condition:	Low	
Internal Neutron detector:	Present	
DoseRate Mode Search/ID in 11 seconds.		
Bklight	OK	Contrast

The "Battery Low" message replaces the clock settings. The SAM 935 will start up, but you should charge the battery as soon as possible.

The SAM 935 will completely shut down about 15 seconds after the "Battery Dead" message appears.

A self-test indicating that the battery back-up for non-volatile information (including spectra and alarms) has failed.

<b>SAM-935</b>		NUM BAT
Status		LOW
Self Test Passed		
Battery condition:		No NU back
Internal Neutron detector:		Present
DoseRate Mode Search/ID in 28 seconds.		
Bklight	OK	Contrast

The SAM 935 should be returned to an authorized service center for NVM battery replacement.

After the self-test has run:

- You can press the OK (F2) function key to override the 30-second delay and start up immediately.

At this point, the SAM 935 may require a coarse calibration. If necessary, you will be prompted to perform a recalibration from the **Utilities/Calib** menu.

When the SAM 935 is ready for operation, the default Dose Rate operating mode (dose rate monitoring) screen will open.

<b>SAM-935</b>		23-Mar-05
Triglist:A	<b>SS Stored Alarms</b>	14:47:30
Full		1.44 $\mu$ rem/h
Neut.	0.10 CPS	
Gamma	102.97 CPS	TotDose: 0.80 nrem
Last Alarm at 23-Mar-2005 14:47:12		
Calib	ID	Srcn On

In Dose Rate operating mode, the instrument continuously takes readings and analyzes isotopes in dose rate (REM) units, storing and reporting any alarm conditions (conditions where the dose rate exceeds the dose rate trigger). The different operating modes are described in Section 6.

The dose rate units are recorded in metric abbreviations of Sievert (Sv) or REMs (R).

Press the SRCH ON (F4) function key to enable or disable the audible search tool. Searching for isotopes is aided by a clicking sound that increases in frequency as the user approaches the source. This is especially helpful to those performing a search operation with external detectors since the user's eyes are generally focused on the detector – not the changing dose rate on the SAM. This function can also be enabled in *Miscellaneous Setup* function under the **Utilities** menu. The audio response time is based on the one second update period. Note that the ambient background count rates are very low and the audio will follow these statistical fluctuations. When a source is present, the intensity (dose rate) will determine the audio frequency.

## **5.2. Recalibrating the SAM 935**

The recalibration procedure described in this section automatically adjusts hardware parameters (for example, high voltage and amplifier gain) to obtain an accurate system energy calibration. This procedure should not be performed by a novice end-user. Please contact the factory. The quick calibration method does not adjust the hardware parameters.

## 5.2.1. Recalibration Procedure

### To reset hardware parameters for calibration:

- If you are performing this procedure because of a detector substitution or replacement, physically install the replacement detector now.
- Procure a 1  $\mu$ Ci Cs137 check source. The source does not need to be calibrated.
- Select a work area with a stable temperature environment.
- Power up the SAM 935.
- From the power-up self-test screen, press F2 (OK) to enter normal operation.
- If the unit requests an Auto Calibration prior to normal operation, press F3 (CALIB) to enter the coarse calibration screen.
- If the unit does not request an Auto Calibration at start up, select the UTIL button while in the normal operating screen.
  1. Select F3 (CALIB) from the menu to open the **Calibration Mode** screen.
  2. Place the 1  $\mu$ Ci Cs137 source at the detector window.
  3. Press F2 (START) to begin the Coarse Adjust process.
  4. Press F4 (SAVE) when the message "Adjustment Complete" appears on the screen.
  5. If the message "Replace previous fine calibration?" is presented, press F2 (DONE) to retain the previous fine energy calibration. If you suspect that the current calibration is faulty, press F3 (REPLACE) instead.

### When choosing *Fine Energy Calibration*, choose "Fine Energy Calibration (factory setting)" from the calibration submenu of the utilities menu.

- When you see the question "Override fine calib?" press F2 (CONTINUE).
- The instrument may prompt you to acquire a new background. IF so, press F3 (ACQUIRE), then F2 (BACKGROUND) once you've cleared the sources from the area.
- Procure a 1  $\mu$ Ci Eu152 check source. The source does not need to be calibrated.
- Select 600 seconds and press ENTER.
- Place the Eu152 source two detector diameters (minimum) away from the detector. For 1.5x2" detectors, this value is 3". For 3x3" detectors, this value is 6".
- Press F2 (ACQUIRE).
- When counting stops, press F4 (ACCEPT).

If not enough peaks were found during the calibration process an error message will appear "Not enough spectrum lines." You will then need to run a new *Fine Energy Calibration* for a longer period (example: 30 minutes). If you still have problems, contact the factory.

If a successful calibration has been performed you will be prompted to accept or save the data. The unit will then process an energy calibration MCA report which should be printed and stored for your records.

## 5.2.2. Restoring Fine Energy Calibration Coefficients Manually

NOTE: This process should only be performed if the fine energy coefficients have been erased or reset.

### To restore fine energy calibration coefficient manually:

1. From the normal operating screen, press the UTIL key.
2. Go to the System Tools submenu. Scroll to Factory Tools submenu.
3. Select *Analysis Tools Setup* and press ENTER.
4. Press ENTER five times to display the message "Set Fine Engy Coeff?"
5. Press F2 (YES) to view and record the three fine energy calibration coefficients. You will be asked to restore factory settings or edit. Select F2 (RESTORE) **only** if you intend to restore the original fine factory coefficients. These factors are labeled C(0), C(1) and C(2) in successive screens. Be sure to record any minus signs found in the formulas. You can find the factory coefficient settings on the label on the back of the controller or on the energy calibration report you received bound to the instrument. At the end you will be prompted to "Change QCC coeff?" Select NO. If you want to change the coefficients, please contact the factory before doing so.

### 5.2.3. Calibrating Dose Rate

The dose rate calibration is a single-point calibration using Cs137 to provide a calibration factor for dose rate monitoring. This value is factory-set and only needs to be changed if:

- A memory reset is performed.
- The detector is replaced.

If the memory is reset, you must either perform the dose rate calibration (using a calibrated Cs137 source near 10 $\mu$ ci) or manually enter the calibration factor.

To perform a dose rate calibration:

- Starting from the normal operating screen, press the UTIL key.
- Press F3 (CALIB) and press ENTER.
- Select *Calibrate Dose Rate* from the **Calibration** menu and press ENTER.
- Press the CALIB function key (F2) to run the dose rate calibration. The screen will indicate that you need a calibrated Cs137 check source of about 10  $\mu$ Ci to perform the calibration.

---

*Note: This message will time out and the SAM will automatically proceed to the next screen if no action is taken.*

---

- Press F3 or F4 to erase the current value.
- Use standard editing methods to enter the known activity of the Cs137check source.
- Press ENTER once the appropriate activity has been input.
- Press the ENTER function key. The **Dose Calibration** (Edit Date) screen will open. Enter the date the Cs137 source was calibrated.
- Press the PREV (F1) function key or left arrow to move the highlighted digit to the right.
- Press the NEXT (F2) function key or right arrow to move the highlighted digit to the left.
- Press the INC (F3) function key to or up arrow increase the value of the highlighted digit.
- Press the DEC (F4) function key to or down arrow decrease the value of the highlighted digit.
- Press the ENTER function key to accept the new date and return to the **Dose Calibration** screen.
- Place the 10 $\mu$ ci Cs137 standard 20 cm (7.87") from the detector end cap and press the OK (F2) function key to start counting.

You will see a spectrum resolve on screen as the calibration runs.

- Press the ABORT (F1) function key to cancel the acquisition.
- Press the ERASE (F2) function key to restart the acquisition.
- The calibration will take approximately 1-3 minutes, after which the screen will display the new dose rate calibration value. When counting is complete, record the new dose rate calibration factor with your fine energy calibration report.

It should be in the range of 1.5 to 3.5. If the factor is significantly outside this range, contact the factory for instructions on how to check the performance of the detector. Detectors with degraded resolution cause the dose rate calibration factor to be much higher than normal. Another common cause of an out-of-range dose rate calibration factor is having the wrong detector size selected

- Remove and store the Cs137 source.
- Press F1 to return to the normal operating screen.

To restore dose rate calibration factors:

1. Select the **Utilities** menu and press ENTER.
2. Select F3 (CALIB) and press ENTER. Scroll down to *Dose Rate Calib* and press ENTER.
3. The screen will reflect the "Current Calib Value." If this value is set to 1.0, then a valid calibration does **not** currently exist.
4. To edit this value select F3 (EDIT) and change the corresponding number. The factory dose rate number is provided on the label on the back of the controller.
5. Press F1 (RETURN) twice to exit back to the **Utilities** menu.

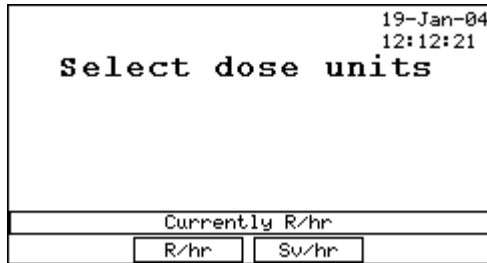
Dose calibrations are now restored.

### 5.3. Configuring Dose Rate Units and Trigger

Because the default operating mode is Dose Rate mode, you may need to configure the Dose Rate Units and Dose Rate Trigger options using the commands in the **Miscellaneous Setup Functions** menu.

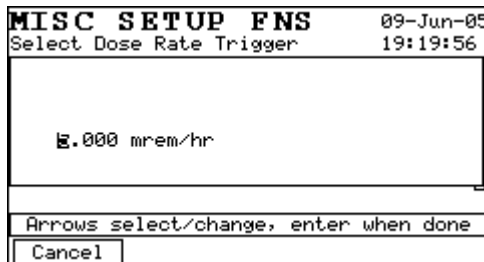
To configure Dose Rate Units and Dose Rate Trigger options:

1. Use the up and down arrow keys to scroll through the screens.
2. Select *Select Dose Rate Units* and press the ENTER function key.
3. Select the units of measurement for monitoring. The message line above the function key labels indicates the selected units.
  - Press F2 for REMs per hour (R/hr).
  - Press F3 for Sieverts per hour (Sv/hr).



4. The display will immediately return to the **Miscellaneous Setup Functions** menu. Use the up and down arrow keys to highlight *Select Dose Rate Trigger* and press the ENTER function key. The dose rate trigger number is used as a threshold for automatic dose rate alarm.

The value shown on the **Miscellaneous Setup Functions**, "Select Dose Rate Trigger" screen is the alarm trigger. An alarm will be generated and saved whenever any surveyed isotope exceeds this value.



5. Use the arrow keys to move from digit to digit, and to increase or decrease the highlighted value. Press the ENTER function key to save the changes.
6. Press the RETURN (F1) function key twice to leave the **Miscellaneous Setup Functions** menu and return to the Dose Rate monitoring screen.



## 6. SAM 935 Operating Modes

Note: The only isotopes that are available for identification in the Dose Rate or Sigma survey screens are the ones that are currently set in the Active Trigger List A, B, or C in the upper left corner of the screen.

The SAM 935 is designed to operate primarily in Dose Rate or Sigma mode, allowing the user to take advantage of the instrument's advanced QCC features.

To enable or disable the display operating modes:

- Press the UTIL function key to open the Utilities menu.
- Use the up and down arrows to select the Misc Setup Functions Submenu.
- Use the up and down arrows to select Select Display Modes and press the ENTER function key.

The **Misc Setup FNS**, "Select Disp Screens" shows all the modes enabled ("Ena").

<b>MISC SETUP FNS</b>		09-Jun-05
Select Disp Screens		19:21:41
Sigma Mode		Ena
Spectra Mode		Ena
Dose Rate Mode		Ena
Press ENTER to return.		
Return	Sigma	Spectra DoseRate

- Press the SIGMA (F2) function key to enable or disable Sigma mode (or peak-to-background monitoring).
- Press the SPECTRA (F3) function key to enable or disable Spectra mode.
- Press the DOSE RATE (F4) function key to enable or disable the default Dose Rate mode.
- Press the RETURN (F1) function key to return to the main Monitor setup menu.

### 6.1. Dose Rate Operating Mode

In dose rate mode, which is the SAM 935 default operating mode, the instrument continuously takes readings and analyzes isotopes in **dose rate units**, saving and reporting any alarm conditions (conditions where the dose rate exceeds the **dose rate trigger**).

A Dose Rate screen with stored alarms.

<b>SAM-935</b>		Reviewing	19-Jan-04
		Stored Alarm	11:49:46
Full		16.16	$\mu\text{R/hr}$
Cesium 137	Cs137 IND	5.81	$\mu\text{R/hr}$
Tot Dose: 882.13 nR			
Alarm # 6 at 19-Jan-2004 11:48:19			
Monitor	Return	Prn Sel	MCA

- Press the ID (F3) function key to provide a sample acquisition (capture) for a preset time while remaining in real time survey mode. This has the advantage of providing sequentially numbered alarms that can be reviewed and analyzed using the multi-channel analyzer. Each stored alarm can provide either Dose Rate or Sigma data during review of its corresponding survey screen. Preset capture times from 6 seconds up to 60 minutes can be entered (the default preset time is one minute). A separate menu item (Set ID Capture Time) is located in the Utilities menu for this procedure. These type of alarms will be labeled "Captured."
- Press the SRCH ON/OFF (F4) function key to enable or disable the audible search tool. Searching for isotopes is aided by a beeping sound that increases in frequency as the user approaches the

source. This is especially helpful to those performing a search operation with external detectors since the user's eyes are generally focused on the detector – not the changing dose rate on the SAM. This function can also be enabled in *Configure Alarm Hardware* under MISC SETUP FNS. The audio response time is based on the one second update period. Note that the ambient background count rates are very low and the audio will follow these statistical fluctuations. When a source is present, the intensity (dose rate) will determine the audio frequency.

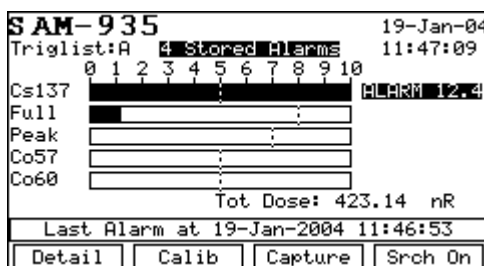
- If "XXX Stored Alarms" is displayed near the top of the screen, indicating that alarms have been stored, pressing the left arrow key will open the last stored alarm for review. Additional key presses will step through the other stored alarms one by one. Pressing the right arrow key does the reverse, starting with the oldest stored alarm.

When in the alarm reviewing mode:

- Press the RETURN (F2) function key to return to the previous survey screen.
- Press the PRN SEL (F3) function key to print the real time dose rate report of the alarm under review.
- Press the MCA (F4) function key to enter the MCA Analysis display screen.

## 6.2. Sigma Operating Mode

In Sigma mode, the display has an bar graph with a continuous readout of the signal strength associated with each isotope being monitored. The display and alarm threshold is drawn in terms of sigma above background.



A vertical dashed line shows the alarm threshold for each trigger. When an alarm occurs:

- The word "Alarm" and the sigma over background (standard deviations) value appear on the screen to the right of the bar graph.
- The last alarm time displays in the message line immediately below the bar graphs.

The bar graph sequence changes with every measurement interval. The most intense alarm measured during the interval is listed first, and the least intense is listed last.

- Press the ID (F3) function key to provide a sample acquisition (capture) for a preset time while remaining in real time survey mode. This has the advantage of providing sequentially numbered alarms that can be reviewed and analyzed using the multi-channel analyzer. Each stored alarm can provide either Dose Rate or Sigma data during review of its corresponding survey screen. Preset capture times from 6 seconds up to 60 minutes can be entered (the default preset time is one minute). A separate menu item (Set ID Capture Time) is located in the Utilities menu for this procedure. These type of alarms will be labeled "Captured."

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*Note: Use of the function key to store an alarm is not required, as the SAM 935 does this automatically.*

---

- Press the ID (F4) function key to enable or disable the audible search tool. Searching for isotopes is aided by a clicking sound that increases in frequency as the user approaches the source. This is especially helpful to those performing a search operation with external detectors since the user's eyes are generally focused on the detector – not the changing dose rate on the SAM. This function can also be enabled in *Configure Alarm Hardware* under Area Monitor Setup. The audio response time is based on the one second update period. Note that the ambient background

count rates are very low and the audio will follow these statistical fluctuations. When a source is present, the intensity (dose rate) will determine the audio frequency.

- If "XXX Stored Alarms" is displayed near the top of the screen, indicating that alarms have been stored, pressing the left arrow key will open the last stored alarm for review. Additional key presses will step through the other stored alarms one by one. Pressing the right arrow key does the reverse, starting with the oldest stored alarm.

When in the alarm review mode:

- Press the RETURN (F2) function key to return to the main Monitor setup menu.
- Press the PRN SEL (F3) function key to print the alarm under review.
- Press the MCA (F4) function key to enter the Alarm MCA Review screen.

### **6.3. Spectra Mode**

The actual spectrum being acquired is displayed in real time 1-second snapshots. If an alarm is in progress, the displayed spectrum represents the accumulated spectrum for the entire alarm. Alarm threshold is based off sigma over background (standard deviations). Use the MCA analysis for identification in this mode.

- Press the ID (F3) function key to provide a sample acquisition (capture) for a preset time while remaining in real time survey mode. This has the advantage of providing sequentially numbered alarms that can be reviewed and analyzed using the multi-channel analyzer. Each stored alarm can provide either Dose Rate or Sigma data during review of its corresponding survey screen. Preset capture times from 6 seconds up to 60 minutes can be entered (the default preset time is one minute). A separate menu item (Set ID Capture Time) is located in the Utilities menu for this procedure. These type of alarms will be labeled "Captured."

---

*Note: Use of the function key to store an alarm is not required, as the SAM 935 does this automatically.*

---

- Press the ID (F4) function key to enable or disable the audible search tool. Searching for isotopes is aided by a clicking sound that increases in frequency as the user approaches the source. This is especially helpful to those performing a search operation with external detectors since the user's eyes are generally focused on the detector – not the changing dose rate on the SAM. This function can also be enabled in Configure Alarm Hardware under Area Monitor Setup. The audio response time is based on the one second update period. Note that the ambient background count rates are very low and the audio will follow these statistical fluctuations. When a source is present, the intensity (dose rate) will determine the audio frequency.
- If "XXX Stored Alarms" is displayed near the top of the screen, indicating that alarms have been stored, pressing the left arrow key will open the last stored alarm for review. Additional key presses will step through the other stored alarms one by one. Pressing the right arrow key does the reverse, starting with the oldest stored alarm.

When in the alarm review mode:

- Press the RETURN (F2) function key to return to the main Monitor setup menu.
- Press the PRN SEL (F3) function key to print the alarm under review.
- Press the MCA (F4) function key to enter the Alarm MCA Review screen.

### **6.4. Background Mode**

The SAM 935 will compare and subtract the last acquired background against all stored spectra collected from that point forward and until a new background is acquired.

To ensure accurate results, it is very important to take frequent background spectra in the actual monitoring location. The background is the point of reference against which readings are measured, and corrects for ambient radioactivity or background from cosmic rays in the area of the detector. The ambient background spectrum is stored and then subtracted from all other collected spectra on a channel-by-

channel basis before they are analyzed. Background spectra can be acquired at any point, and should be taken:

- Whenever the ambient background changes (for example, if the instrument is moved to a new location or if a patient who received a radionuclide dose enters or leaves the vicinity).
- Before doing a fine energy calibration.

Because the counting statistics in the background spectrum directly affect the uncertainty in the analyzed spectra, the background should be counted for a long time compared to the sampling interval. If you are operating with a 1-second sample time (the default), a background collection time of 60 seconds or longer is appropriate.

The most likely causes for high background readings are:

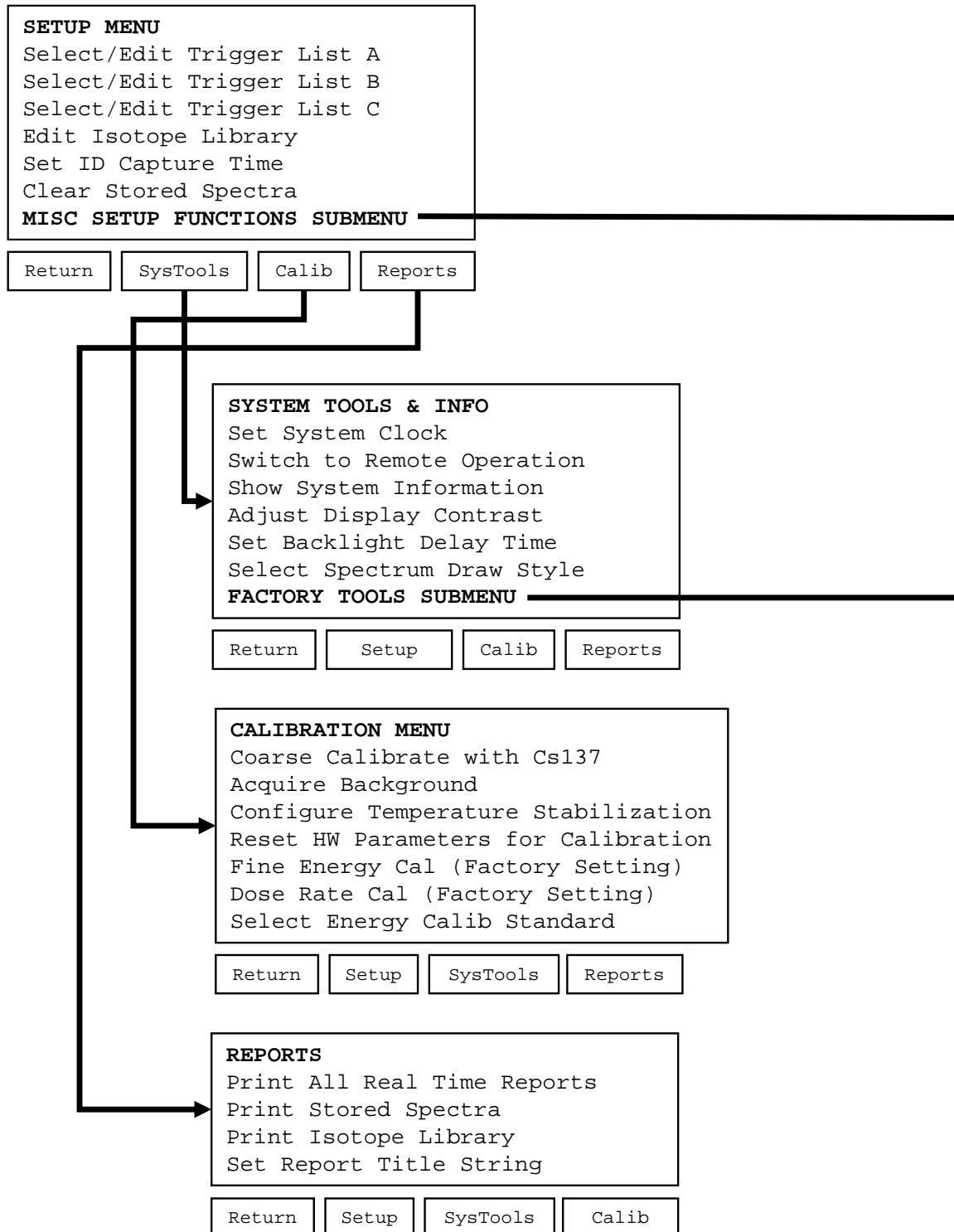
- The presence of radioactive materials near the counter in the form of samples or standards.
- High concentrations of natural radioactive material such as K40 in the building materials.

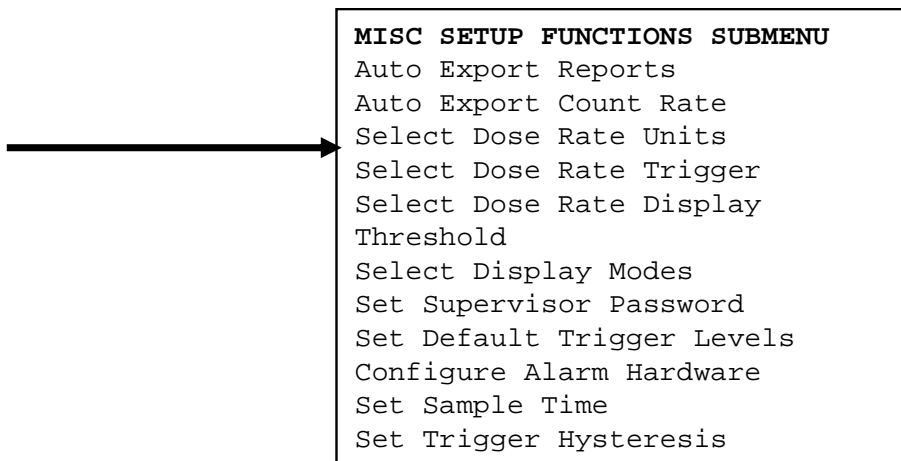
Less likely causes include:

- Concrete or cement block construction.
- High radon levels.

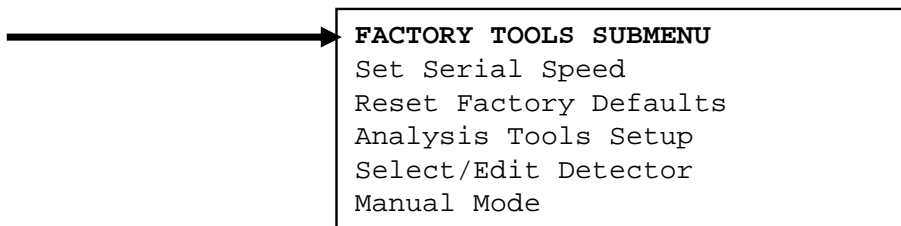
## 7. Utilities

### Utilities Menu Flow Chart





Return



Return

## 7.1. *Selecting Triggers*

You can configure the SAM 935 to monitor up to 22 triggers at a time. There are three different types of triggers:

- **Isotope** mode uses any isotope selected from the isotope library.
- In **Full** mode, the total counts in the entire spectrum are summed and compared to the background.
- In **Unidentified** mode, the spectrum is searched for identifiable peaks. Any peaks found that are not associated with the isotopes being monitored are rolled up into the <UNID> trigger.

You can set the sensitivity of each trigger independently. You can also control several parameters that affect the overall sensitivity of the SAM 935 and its ability to discriminate false-positive triggers.

To use multiple Trigger lists:

There are three trigger lists, labeled A, B and C. It may be advantageous to separate isotopes with conflicting energy lines between the lists. These trigger lists are accessed under Utilities menu. The specific trigger list selection is presented as the first screen when the user selects the Select Triggers option. In operation, the trigger list in use will be displayed in the upper left-hand corner of the Survey screen (for example, Triglist: A).

**Pu239 trigger:** To use the Neutron Coincidence feature:

It may be difficult for a newly trained, first-line responder to identify plutonium with a high degree of confidence. The low abundant 379 keV gamma line (doublet) may take nearly a minute or more to resolve, especially with small amounts of plutonium under one gram. Since there may be confusion between what is background and what is the defining gamma line, a neutron – gamma coincidence will raise the confidence level when identifying Pu239. (Note that the final decision must still involve the specialist who can determine the spectral details). This feature, if desired, is selected when entering Pu239 in the trigger list. At this point you may choose the coincidence option (Yes) or maintain independent neutron and gamma alarms (no).

In **Sigma** and **Spectra** modes only, the strength of a trigger is measured in terms of standard deviations above background, where the background is measured over the same region of the spectrum. For example, in the case of a full spectrum, if the number of counts per second in the background spectrum was 100, then its standard deviation would be 10. If the number of counts in a measurement period was 145 counts per second, then the net counts above background would be  $145 - 100 = 45$ , and the reported ratio would be  $45/10 = 4.5$ . This would trigger an alarm if the corresponding trigger level was set to 4 or less.

Trigger levels up to 255 can be used.

To select or edit the specific triggers monitored by the SAM 935:

- Use the up and down arrows to highlight *Select/Edt Triggers* in the **Setup** screen, and press the ENTER function key. A list of isotopes will appear.



Four entry types are available, and the function keys change depending on the selected entry type, as shown in the following examples.

### FULL entry type

SETUP MENU		09-Jun-05
Select/Edit Trigger List A		19:23:04
Full	8	
Unid Pk	7	
Cs137	5	
Co57	5	
Co60	5	
K40	5	
Select component and edit		
Return	Delete	Trig Lvl

- Press the RETURN (F1) function key to return to the main **Setup** screen.
- Press the DELETE (F3) function key to delete the selected trigger from the list.
- Press the TRIG LVL (F4) function key to change the trigger level. Use the left and right arrows to select a digit. Use the up and down arrows to change the digit. Press the ENTER function key to save the new value.
- Press the RETURN (F1) function key to return to the main **Setup** screen.
- Press the DELETE (F3) function key to delete the selected UNID trigger from the list.
- Press the TRIG LVL (F4) function key to change the trigger level. Use the left and right arrows to select a digit. Use the up and down arrows to change the digit. Press the ENTER function key to save the new value.
- Press the CANCEL (F1) function key to return to the main **Setup** screen.
- To add a trigger, use the up and down arrow keys to select the isotope to be replaced, or an empty entry. Press the EDIT (F2) function key to select an isotope from the library. Use the up and down arrow keys to highlight the isotope and press the ENTER function key to accept it. Press the CANCEL function key to return to the screen shown above. Note that adding an isotope automatically enables it for MCA analyses.
- Press the DELETE (F3) function key to delete the selected isotope from the list. When an isotope is deleted from the last of the trigger lists, it is also disabled for MCA analyses, though it can be manually re-enabled if desired. (See Section 7.2.2 below.)
- Press the TRIG LVL (F4) function key to change the trigger level. Use the left and right arrows to select a digit. Use the up and down arrows to change the digit. Press the ENTER function key to save the new value. The default trigger level for a specific isotope is 5.
- Press the RETURN (F1) function key to return to the main **Setup** screen.

## **7.2. Edit Isotope Library**

The isotopes database contains the following information on more than 90 isotopes:

- Nuclide name
- Half-life in common units
- Units identifier
- Enabled flag
- Class category

The database has room for 128 isotopes and 400 energy lines, so, if necessary, you can add new ones.

Use the **Edit Isotope Library** menu command to:

- Add new isotopes.
- Delete isotopes.
- Edit an isotope's data or enable/disable isotopes.

To edit isotopes:

Use the up and down arrows to highlight the Edit Isotope Library command in the **Setup** menu.

Press the ENTER function key to open the **Utilities**, "Edit Isotope Library" menu.

Use the up and down arrow keys to search for or select an isotope from the library.



- Press the RETURN (F1) function key to return to the Utilities menu.
- Press the ADD (F2) function key to add a new isotope.
- Press the DELETE (F3) function key to delete the highlighted isotope from the list.
- Press the EDIT (F4) function key to edit isotope information.

### 7.2.1. Adding a New Isotope

- Press the ADD (F2) function key to add a new isotope. A new entry (Name) will be added to the bottom of the list.

UTILITIES			19-Jan-04
Edit Isotope Library			14:18:26
Pu239	24130	Y	
Am241	432.2	Y	
Ba133s	10.52	Y	
Th232s	1.405e+10	Y	
U235s	7.038e+08	Y	
Name 0 0 Ena			
SELECT ISOTOPE			
Return	Add	Delete	Edit

- Press the EDIT (F4) function key to open the Edit Isotope, "Name" screen:

Edit Isotope		19-Jan-04
Edit Name		14:21:31
ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz !"#%&'()*+,-./0123456789: Name		
USE ARROWS TO SELECT CHARACTER		
Cancel	Select	Delete Space

- Press the RETURN (F1) function key to return to the Utilities menu.
- Press the EDIT ISO (F2) function key to edit the isotope information.
- Press the EDIT RAD (F3) function key to edit lines in the radiation database for the new isotope.
- Press the ENABLE/DISABLE (F4) function key to enable or disable an isotope for MCA analysis.

### 7.2.2. Enabling/Disabling Isotopes

*MCA analysis report only considers enabled isotopes in searches and qualitative analysis.*

---

*Note: Enabling or disabling isotopes is applicable for operations with Manual Mode/MCA operations, but does not apply to the isotopes selected in the trigger lists used by Sigma/Dose Rate modes. In other words, add isotopes to the currently selected trigger list for Sigma/Dose Rate operations, and the isotopes added will automatically be enabled in the library for use in Manual Mode/MCA analysis operations. When an isotope is removed from all trigger lists, it will automatically be disabled in the library, but it may be manually re-enabled as described below.*

---

To enable an isotope:

- Use the up and down arrow keys to highlight it.
- Press the EDIT (F4) function key to open the **Edit Isotope** screen.
- To enable or disable the isotope press the ENABLE/DISABLE (F4) function key. The isotope status is indicated in the **Edit Isotope** screen.

### 7.2.3. Editing Isotope Information

#### To edit isotope information:

- Press the EDIT ISO (F2) function key in the **Edit Isotope**, "Name" screen to edit the isotope label. Note that when a new isotope is created, it is designated onscreen as "Name" until you enter the correct value.
- Edit the isotope name using the text, numbers and symbols in **Edit Isotope**, "Edit Name" screen.
- Press the ENTER function key to open the **Edit Isotope**, "Edit Half-Life" screen. If necessary, edit the value of the half-life.
  - Press the CANCEL (F1) function key twice to return to the main **Edit Isotope** screen.
  - Press the SELECT (F2) function key to insert a highlighted digit.
  - Press the BACK (F3) function key to backspace and delete a selected digit.
  - Press the CLEAR (F4) function key to clear all existing values.
- Press the ENTER function key to open the **Edit Isotope**, "Edit Half-Life Units" screen. If necessary, use the up and down arrow keys to select the appropriate half-life unit. Press the ENTER function key to change the unit and view the next screen.
- Use the arrow keys to change the isotope class. Press the ENTER function key to return to the main "Edit Isotope" screen.

### 7.2.4. Editing Isotope Radiations

The radiations database contains 293 lines. You can add lines to existing isotopes or add new isotopes with lines up to a maximum total of 400.

#### To edit existing radiations:

- From the **Edit Isotope** screen, press EDIT RAD (F3) to display the **Edit Radiations** screen.
- Select an existing line to edit and press EDIT (F4) or press the ADD (F2) function key to add a new line for this isotope. There are four numbers (in successive screens from left to right) corresponding to each radiation.
  - The line energy in keV. If necessary, edit the line energy and press the ENTER function key.
  - The line intensity, measured in terms of gammas per 100 disintegrations. If necessary, edit the line intensity and press the ENTER function key.
  - The detector efficiency for the line. Normally, you will not need to edit this value. The efficiency actually used in dose rate and Sigma monitoring calculations is based on the detector efficiency model.
  - The summing correction, set to the default value of 1.00.
- On the last screen, the F2 function key sets the line being edited to PRIMARY, F3 to ENABLED, and F4 to DISABLED.

#### To add radiations:

- If this is a newly added isotope and no lines have been added yet, press the ADD (F2) function key to start a blank line. Then press the EDIT (F4) function key to edit the new line items. Repeat as needed.
- Press the RETURN (F1) function key to return to the main **Edit Isotope** screen.

### 7.2.5. Printing the Isotope Library

You can print the nuclide and radiation information for a single isotope or the entire isotope database.

#### To print isotope database information:

- Press UTIL and select REPORTS (F4)
- Use the up and down arrow keys to highlight Print Isotope Library in the **Utilities** menu and press the ENTER function key to select it.
- The **Print Isotope Library** screen will open.

#### To print a single nuclide:

- Press the PRN SEL (F2) function key or select "Print selected isotopes" from the main menu to display a list of isotopes.

UTILITIES				23-Feb-04
Select Isotope				09:21:01
Co57	271.79	D	Prt	
Ga67	3.261	D		
In111	2.805	D		
Cs137	30	Y	Prt	
Co60	5.27	Y	Prt	
Mn54	312.12	D	Prt	
SELECT ISOTOPE				
Cancel		Deselect		

- Use the up and down arrow keys to highlight the isotope you want to print and press the SELECT (F4) function key. Repeat the procedure for each isotope you want to print.
- When you have selected all the isotopes you want to print, press the ENTER function key to send the list to the printer.

#### To print enabled isotopes:

- Press the PRN ENA (F3) function key.
- OR**
- Use the up and down arrow keys to select "Print enabled isotopes" from the main menu and press enter.

Press the RETURN (F1) function key to return to the main menu.

### **7.3. Set ID Capture Time and Auto Export**

- The first screen allows setting the preset time for ID/Capture time. Default is one minute.

SETUP MENU		09-Jun-05
Set ID Capture Time		19:24:10
1.0 minutes		
Arrows select/change, enter when done		
Cancel		

- The SAM 935 provides for an automatic MCA report to be sent out the RS232 port without manipulating the soft key.
- If Auto Export is disabled, any alarm reached during normal survey mode operation will save the alarm and a spectrum acquired during the duration of the alarm.

MISC SETUP FNS		09-Jun-05
Auto Export		19:25:09
Auto export currently disabled		
Press ENTER to return.		
Enable		

- If Auto Export is enabled, any alarm reached during normal survey mode operation will start an automatic ID/Capture using the preset time set as mentioned above. The ddata report will be automatically sent out the RS232 port.

```

MISC SETUP FNS      09-Jun-05
Auto Export         19:25:54
Auto export currently enabled
Realtime reports currently disabled
MCA reports currently disabled

Press ENTER to return.

[Disable] [Sigma] [MCA]

```

- If Real Time Reports are enabled, the following style report is automatically transmitted at the end of the Capture analysis time.

#### Real Time Report

```

Alarm #   5 at 01-Jun-2005 13:41:21 for 60 sec (captured)   SAM Serial #: 90521
Nuclide(s)      Peak Conf   Total Conf   Peak Dose      Avg Dose
Full           36.38       36.08       10.50 urem/hr   10.50 urem/hr
Unid Pk        9.09        9.05        0.00 nrem/hr    0.00 nrem/hr
Cs137          1.89        1.84       50.60 nrem/hr   49.32 nrem/hr
The following monitors had no measured activity:
Co60 K40
Gamma counts/sec:    235.78

```

- If MCA Reports are enabled, the following style report is automatically transmitted at the end of the ID/Capture analysis time:
- Press the ENTER key to exit.

## 7.4. Clearing Stored Spectra

All stored spectra are held in memory until erased.

#### To clear stored spectra:

- Use the up and down arrow keys to select Clear Stored Spectra from the **Setup** menu. The warning screen shown below will appear.

```

19-Jan-04
14:44:34
Warning - All spectra
will be cleared!
This will also clear all alarms!

Press CONTINUE to erase spec & alarms

[Continue] [Abort]

```

- The Clear Stored Spectra command **erases all spectra, including alarms, backgrounds, and saved calibration spectra. Once the data is erased, it cannot be retrieved.**

---

*Note: SAM 935 will not allow you to delete individual stored spectra.*

---

- Press the CONTINUE (F2) function key to erase the spectra.
- Press the ABORT (F3) function key to cancel the operation and return to the **Setup** menu.

## 7.5. Miscellaneous Setup Functions Submenu

### 7.5.1. Configuring Alarm Hardware

To configure the alarm hardware:

Use the up and down arrow keys to select Configure Alarm Hardware in the **Setup** screen. Press the ENTER function key to go to the Configure Alarm Hardware menu in the MISC SETUP FNS screen.

```
UTILITIES                                19-Jan-04
Configure Alarm Hardware                 14:04:46
* Keyboard Beep                         Ena
Internal Audio Alarm
Gamma Alarm LED (red)                  Ena
Neutron Alarm LED (yel)                Ena
Audible Search Tool

Return  Disable
```

You can enable and disable the following items:

- Keyboard Beep
- Internal Audio Alarm
- Gamma Alarm LED (red)
- Neutron Alarm LED (yellow)
- Audible Search Tool

---

*Note: The Audible Search Tool can also be Enabled/Disabled by pressing F4 on any survey screen.*

---

Use the up and down arrow keys to highlight the selected item.

Press the RETURN function key to return to the **Setup** screen.

### 7.5.2. Setting the Sample Time

The SAM 935 collects and analyzes data in real time. The Sample Time is the data acquisition time, sometimes called the time slice.

- The minimum sample acquisition time is one second.
- A 3 to 5 second acquisition time is typical for dose rate monitoring.
- A 1 to 2 second acquisition time is usually adequate for isotope identification (Sigma Mode).
- Select a short sample time if a quick response is required (for example, in cases where the radioactivity may be moving).

To set the sample time:

- Select Set Sample Time from the **Setup** menu:

```
MISC SETUP FNS                        09-Jun-05
Sample Time                           19:26:44

1 seconds

Arrows select/change, enter when done
Cancel
```

- Use the up and down arrow keys to increase or decrease the sample acquisition time (in seconds).

Press the ENTER function key to accept the value when finished. Press the CANCEL function key to exit without changing the original value.

### 7.5.3. Setting Trigger Hysteresis: Preventing False Alarms

Use the Set Trigger Hysteresis command in the **Misc Setup Function** menu to mask out unnecessary alarms.

One of the most common causes of a false alarm is a burst of radiation from a cosmic ray that causes a very short-term pulse of counts. To prevent this type of event from triggering an alarm, configure an On Hysteresis to require that two consecutive sample time intervals exceed trigger levels.

Hysteresis refers to the lag time between a cause and its result. On Hysteresis determines the starting conditions of a trigger event. Off Hysteresis determines the ending conditions of a trigger event.

To configure the instrument:

- Select Set Trigger Hysteresis on the **Misc Setup Function** menu.
- Use the up and down arrow keys to increase or decrease the value. The value is the consecutive sample interval that must be exceeded before an alarm will be triggered.
- Press the ENTER function key when finished. Press the CANCEL function key to exit without changing the original value.

If the radiation source is very close to the trigger threshold, a stream of trigger events can occur. The Off Hysteresis setting is used to prevent this problem.

Consider a situation where the radioactive source is at a level where a trigger is generated 80% of the time (possible when, even with a constant source, there is statistical variation in the count rate).

In the example below, an X represents a trigger and a period represents a non-trigger. Consecutive triggers are recorded as a single event. A source with an 80% trigger rate passing by might look like this:

[illegible]

With an On Hysteresis of 1 and an Off Hysteresis of 1, the generated events would be represented by the second line in the example above. Note that 9 separate events are recorded, with the repeated numbers representing consecutive triggers that are recorded as a single event. If On Hysteresis is increased to 2 and Off Hysteresis is left at 1, then only 7 events are generated. The single-trigger intervals are eliminated. When Off Hysteresis is set to 2, the entire period is considered a single alarm.

#### 7.5.4. Setting the Default Trigger Levels

The factory-set default trigger levels are:

All Isotopes	5
Full Spectrum	8
Unidentified Peak	7

Default values apply only when an item is added to the list of triggers being monitored.

To change the default trigger levels:

- Use the up and down arrow keys to set default trigger levels on the **Misc Setup Function** screen:  
*Set Default Iso Trigger*  
*Set Default Full Trigger*  
*Set Default Peak Trigger*
- Press the ENTER function key to open the screen.

- Use the left and right arrow keys to select a digit. Use the up and down arrow keys to increase or decrease the value.
- Press the ENTER function key when finished. Press the CANCEL function key to exit without changing the original value.

### 7.5.5. Setting the Supervisor Password

To set up password protection to prevent unauthorized access to the Utilities menu:

- Use the up and down arrow keys to highlight *Set Supervisor Password* from the **Misc Setup Function** menu.
- Press the F1, F2, F3 and F4 function keys to select a numerical password up to eight digits in length. Each selected digit will be displayed as an X on the screen.

Enter Password		19-Jan-08	
Enter new passwd		14:13:50	
Password will not be displayed			
1	2	3	4

- Press the ENTER function key to save the password.
- If you decide not to have a password, simply press ENTER 3 times without pressing any of the function keys and the password will be cleared.
- Please be sure you know the password or have it recorded in a secure location. Otherwise, it may be necessary to return the unit to the factory to reset or clear the password.

### 7.5.6. Selecting Display Modes

To enable or disable the Sigma, Spectra and Dose Rate mode display screens:

- Use the up and down arrow keys to highlight *Select Display Modes* and press the ENTER function key to select it.

In the Misc Setup Function, "Select Disp Screens" screen:

- Press the RETURN (F1) function key to return to the main Sigma Setup screen.
- Press the SIGMA (F2) function key to enable or disable the Sigma mode display screen.
- Press the SPECTRA (F3) function key to enable or disable the Spectra mode display screen.
- Press the DOSE RATE (F4) function key to enable or disable the Dose Rate mode display screen.

## 7.6. System Tools

### 7.6.1. Selecting Spectrum Draw Style

The SAM 935 can display spectral data in point, line or filled (bar) mode. You can select the display mode of both the main spectrum and the ROIs. It is recommended that you test different options to find the best combination.

To select the spectrum draw style:

- Use the up and down arrows to select *Select Spectrum Draw Style* from the **System Tools & Info** menu. Press the ENTER function key to open the "Select Style" screen.
- Use the up and down arrow keys to select the appropriate combination from the menu and press the ENTER function key to save it.
- Press the CANCEL (F1) function key to return to the **System Tools & Info** menu.

## 7.6.2. Showing System Information

The **System Info** screen displays the model number, firmware release number, manufacturing date, memory capacity and the manufacturer's serial number of your device. This information is very important for troubleshooting, and also shows the current baud rate setting for your communication port. The average neutron CPH will be shown when the optional neutron detector is installed. If auto calibration (stabilization) is enabled, the "Stab" line gives information including the most recently measured percentage error.

To view system information:

- Use the up and down arrow keys to select Show System Information from the **System Tools & Info** menu.

Press the ENTER function key to open the following screen. Note that no changes can be made to this screen.

```
SYSTEM INFO                28-Mar-05
SAM-935                    16:04:06
Release: 02.11.00 (built 2005-03-28)
Mfg Date: 01-Jan-2005
Serial #: 10000
RS232 19200 BPS
NUM: 24984/24996; VOL: 19092/32760
Stab: try 21s, succ 21s, adj -0.36%
Avg Neutron CPH: 165

Press any key to return.
```

- Press any key to exit this screen and return to the **System Tools & Info** menu.

## 7.6.3. Setting the System Clock (Date and Time)

To change the system date and time:

- Use the up and down arrow keys to select *Set System Clock* from the **System Tools** menu.
- Press the ENTER function key. The first screen will display the date. The second screen will display the time. If you only need to edit the time, press the ENTER function key to go to the time display screen.
- Select each value you want to change.
  - To move one character to the right, press the NEXT (F2) function key or the right arrow key.
  - To move one character to the left, press the PREV (F1) function key or the left arrow key.
  - To increase the value, press the INC (F3) function key or the up arrow key.
  - To decrease the value, press the DEC (F4) function key or the down arrow key.
  - Press the ENTER function key to save the changes and return to the Utilities menu.

## 7.6.4. Setting the Backlight Delay Time

You can set a delay time for the display backlight. The backlight will turn off if there is no activity during the specific delay time. To turn the backlight on, press any key. Because using the backlight increases the battery discharge rate, using small timeout settings will allow longer "on" times in the field.

To set a backlight delay time:

- Use the up and down arrows to select *Set Backlight Delay Time* from the **System Tools** menu.
- Press the ENTER function key to open the **Set Bklt Delay Time** screen.

The default value is 300 seconds and the maximum value is 864000 seconds. The minimum value of zero turns the backlight off.

- To move one character to the right, press the right arrow key.
- To move one character to the left, press the left arrow key.
- To increase the value, press the up arrow key.



- To decrease the value, press the down arrow key.
- Press the ENTER function key to save the value and return to the **System Tools** screen.
- Press the CANCEL (F1) function key to return to monitoring mode.

### 7.6.5. Switching to Remote Operation

The SAM 935 can be connected and operated from a remote computer through a standard RS-232 COM port.

To place the SAM 935 in remote mode to allow the remote computer to control it:

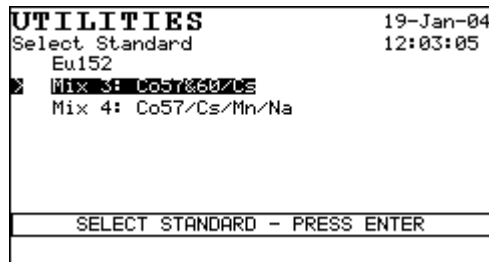
- Use the up and down arrow keys to select *Switch to Remote Operation* from the **System Tools & Info** menu.
- The instrument will remain in remote mode until the EXIT (F1) function key is pressed.
- This mode will be used when running Quantum<sup>®</sup> software.

## 7.7. Calibration

### 7.7.1. Selecting the Energy Calibration Standard

Note: Contact the factory if you are planning to do a fine calibration with a mixed source.

Three pre-defined isotope combinations are available for performing an energy calibration on the SAM series of instruments. Choose Select Engy Cal Standard from the **Utilities** menu to open the "Select Standard" screen.



- The use of Eu152 or Mix 4 (Co57, Cs137, Mn54 and Na22) will result in optimizing the use of the SAM unit for isotopes whose energies are mostly below or not much above 1.5 meV. The default factory calibration is based on the use of Eu152.
- The use of Mix 3 (Co057, Cs137 and Co60) is recommended for those applications where the need to identify the higher energy lines up to 3 meV is required. This combination is better for the higher energy lines due to the use of the Co60 sum peak at 2505.7 keV during calibration. It is important that the source being used has enough Co60 activity to produce a strong enough peak at 2505.7 keV to be seen and used by the calibration routine.
- Be SURE to follow the on screen directions to place the source 2 detector diameters away from the detector end cap if calibrating with Eu152.

## 7.8. Reports

### 7.8.1. Setting the Report Title String

Each printed report has a 36-character title at the top.

To enter a report title:

- Use the up and down arrow keys to select the *Set Report Title String* from the **Reports** menu.

Press the ENTER function key to open the **Reports**, "Set Report Title" screen.

## 7.8.2. Printing Stored Spectra

All alarms, captures and backgrounds are automatically saved in the SAM memory. You can print reports of the saved spectra in the order in which they were collected. The reports will be identical to those that would have been printed at the original collection time. If new background spectra or new calibrations were taken during data collection, the reports will be printed in correct sequential order.

To print stored spectra:

Use the up and down arrow keys to select **Print Stored Spectra** from the **Reports** menu.

## 7.8.3. Printing All Real Time Reports

Select *Print All Real Time Reports* to print out all dose rate reports (alarms) to the printer or PC. Choosing this option will not change the appearance of the SAM screen.

The resulting report printout will have the following style:

### Real Time Report

```
Alarm #    5 at 01-Jun-2005 13:41:21 for 60 sec (captured)    SAM Serial #: 90521
Nuclide(s)      Peak Conf    Total Conf    Peak Dose      Avg Dose
Full            36.38        36.08        10.50 urem/hr   10.50 urem/hr
Unid Pk         9.09         9.05         0.00 nrem/hr    0.00 nrem/hr
Cs137           1.89         1.84         50.60 nrem/hr   49.32 nrem/hr
The following monitors had no measured activity:
Co60 K40
Gamma counts/sec:    235.78
```

## 7.9. Factory Tools Submenu

### 7.9.1. Setting the Serial Speed

The **Set Serial Speed** screen contains commands allowing you to select the RS232 transmission speed for your SAM 935.

---

*Note: Unless the user has specific requirements, 19200 is the recommended speed.*

---

To select the speed:

- Use the up and down arrow keys to select *Set Serial Speed* from the **Factory Tools** menu.
- Press the ENTER function key to open the screen:
- Use the up and down arrow keys to select the speed that matches your printer or computer, and press the ENTER function key. A confirmation message, "RS232 speed set to XXXX," will appear in the message line.
- Press the RETURN (F1) function key to return to the **Factory Tools** screen.

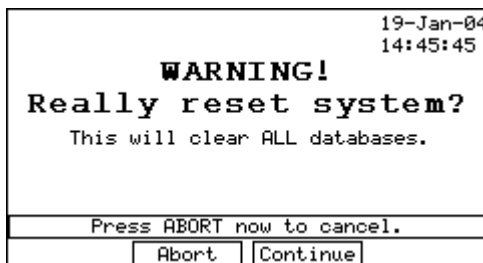
### 7.9.2. Resetting Factory Defaults

The *Reset Factory Defaults* function performs a complete initialization of memory and returns all settings to the factory default values.

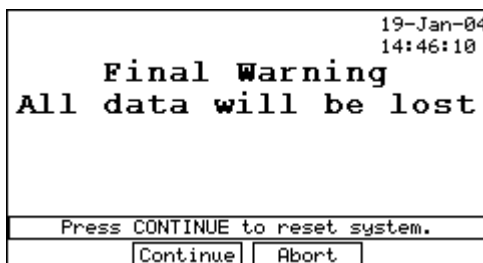
**Warning: The reset will erase ALL calibrations, alarms, spectra and database changes and additions. This procedure should be done only if the battery-backed-up memory where the data is stored becomes corrupted and must be returned to the initialized condition. Always contact technical support BEFORE using this function. You will need to recalibrate both fine and dose rate calibrations if this procedure is performed.**

To perform a memory reset:

- Use the up and down arrow keys to select *Reset Factory Defaults* from the **Factory Tools** menu.
- Press enter to open the following warning screen.

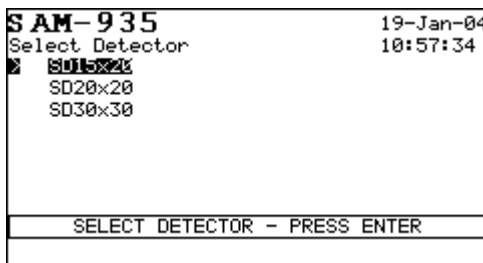


- Select ABORT (F2) to cancel the operation and return to the **Factory Tools** screen.
- Select CONTINUE (F3) to perform the memory reset. You will see a second warning screen.



- Select ABORT (F3) to cancel the operation and return to the **Factory Tools** screen.
- When prompted to reset serial number, select "No."
- Select CONTINUE (F2) to perform the memory reset.

After the memory reset is complete, the SAM 935 will prompt you to select the detector type before it performs the self-test and start up.



Because all stored information was erased, you must perform a complete recalibration after a memory reset. If you cannot perform a fine energy calibration, you can manually enter the quadratic coefficients using the Analysis Tools Setup option in the **Factory Tools** menu. You will also need to re-enter the dose rate calibration value.

### 7.9.3. Setting up Analysis Tools

*Please contact the factory before making any changes described in this section. Expert users only.*

*To edit the fine energy coefficients in the analysis tools setup, select ENTER 5 times to bypass this section.*

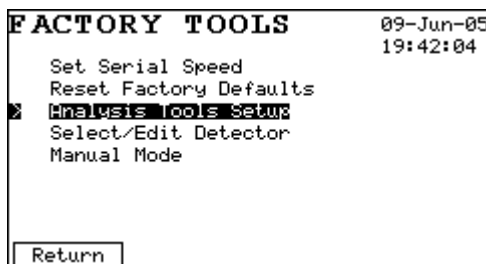
You can set up a number of parameters to control the peak search and peak matching functions of the SAM 935.

The energy match window parameters and ROI width parameters affect the overall monitoring operations.

The other parameters only influence the qualitative analysis done in Manual operating mode.

### To set up analysis tools:

Use the up and down arrow keys to select Analysis Tools Setup from the **Utilities** screen.



Once you enter the **Tools Setup** menu, you will be led through five screens:

- "Energy Match Window A (A + Bx)"
- "Energy Match Window B (A + Bx)"
- "Minimum Correlation for Detection"
- "Peak Finder ROI Width"
- "Max Peak Uncertainty"

"Max Peak Uncertainty" and "Minimum Correlation for Detection" are used in Manual operating mode to determine which isotopes will be identified.

You can press the CANCEL function key (F1) at any time to leave the values on the current and following screens unchanged, but any changes made on earlier screens will be saved.

After editing all other setup information, you may enter 3 fine energy calibration quadratic coefficients if needed. Each one will be presented in a separate display.

#### **7.9.3.1 The Energy Match Window A (A + Bx) Screen**

The energy match window A and B parameters define a tolerance of  $\pm(A+Bx)$  in terms of the energy of the measured peak. Only the isotope lines falling inside this window are considered in the peak identification process.

The default for window A is 6.000 keV. It may be necessary to increase this to 8 prior to calibrating some detectors. After completing a fine (quadratic) energy calibration to specifications, this value can be reduced to "6."

The default for window B is 0.025 keV. It may be necessary to increase this to 0.055 prior to calibrating some detectors. After completing a fine (quadratic) energy calibration to specifications, this value can be reduced to "0.025."

Use the left and right arrow keys to highlight a number or a symbol. Use the up and down arrow keys to move from the number selections to the symbol selections.

- Press CANCEL (F1) to exit without changing the original value.
- Press the SELECT (F2) function key to add a selected digit or symbol to the keV/chan value.
- Press the BACK (F3) function key to subtract a selected digit or symbol from the keV/chan value.
- Press the CLEAR (F4) function key to clear the current value.

Press the ENTER function key to move to the Tools Setup, "Min correlation for detection" screen.

#### **7.9.3.2 Min Correlation for Detection Screen**

The default minimum correlation value is 0.65.

If you increase the minimum correlation value (in the range of 0.2 to 0.79), the required accuracy of the measured relative intensities of multi-line isotopes will increase. If you increase the value, the system will misidentify fewer isotopes, but will be more likely to reject matches for one isotope in the presence of another.

### 7.9.3.3 The Peak Finder ROI Width Screen

The default ROI width is 11 channels for planar detectors and ADC settings of 256 channels at 3 meV energy range. An ADC mode of 512 channels will normally require an ROI width of about 19-21. This value corresponds to a detector FWHM of approximately 7.5% at 662 keV. If your detector resolution is significantly better or worse, you can change this resolution to more accurately resolve peaks. Any change made to the ROI width setting will require a new dose rate calibration. A degraded FWHM of 8.5% or higher requiring a larger ROI width setting will reduce the ability to identify isotopes with close peaks (such as Co60).

### 7.9.3.4 The Max Peak Uncertainty Screen

The default maximum uncertainty value is 1.0.

The value requires that peak counts be at least N times higher than the counting uncertainty before the peak is used in matching. This is useful for discarding low count-rate peaks from noisy spectra. A value of 0 means that all peaks will be accepted. A higher value, such as three or above, would require that the peaks be larger before being accepted.

### 7.9.3.5 Setting and Editing Fine Energy Coefficients

Select YES if you would like to manually re-enter the fine energy coefficients, or would like to restore the defaults saved in the device.

19-Jan-04  
14:34:26

Set fine engy coeff?  
Reset these only  
if lost and no cal std is available.

YESNO

Select RESTORE if you would like to restore the original factory fine energy coefficients. This will update the values and continue to the next step. Select EDIT to proceed with manual entry of the values.

09-Jun-05  
19:43:03

Do you want to:  
  
RESTORE factory settings or EDIT?

Choose edit only if restore fails.

RestoreEdit

EDIT will take you through the following three screens which allow you to edit the three calibration factors for the fine (Quadratic) energy calibration.

TOOLS SETUP23-Feb-04  
Fine engy coeff C(0)09:22:31

01234  
56789  
--+.e  
-4.5986e-01

USE ARROWS TO SELECT DIGIT

CancelSelectBackClear

<b>TOOLS SETUP</b>		23-Feb-04
Fine engy coeff C(1)		09:22:50
<div style="border: 1px solid black; padding: 5px;">             1234              56789              --+.e  <span style="background-color: black; color: white;">1.0000e+00</span> </div>		
USE ARROWS TO SELECT DIGIT		
Cancel	Select	Back Clear

<b>TOOLS SETUP</b>		23-Feb-04
Fine engy coeff C(2)		09:22:58
<div style="border: 1px solid black; padding: 5px;">             1234              56789              --+.e  <span style="background-color: black; color: white;">0.0000e+00</span> </div>		
USE ARROWS TO SELECT DIGIT		
Cancel	Select	Back Clear

Normally, this ability would be used only when, due to a problem or firmware reset, the calibration factors are lost (or corrupted) and need to be restored. Do not change any of these factors unless the values are known from a previous calibration.

#### 7.9.3.6 Changing QCC Coefficients

---

**WARNING: Do not change the QCC Coefficients without consulting the factory first.**

---

19-Jan-04 14:34:35	
<b>Change QCC coeff?</b> <b>Do not change</b> unless you have read the manual.	
YES	NO

If you select "Yes," the following two screens allow you to edit the basic nature of the QCC data collection.

<b>TOOLS SETUP</b>		23-Feb-04
QCC offset		09:23:11
<div style="border: 1px solid black; padding: 5px;">             1234              56789              --+.e  <span style="background-color: black; color: white;">3.0000</span> sqrt(chan)           </div>		
USE ARROWS TO SELECT DIGIT		
Cancel	Select	Back Clear

<b>TOOLS SETUP</b>		23-Feb-04
QCC slope		09:23:25
<div style="border: 1px solid black; padding: 5px;">             1234              56789              --+.e  <span style="background-color: black; color: white;">60.9999</span> sqrt(chan)           </div>		
USE ARROWS TO SELECT DIGIT		
Cancel	Select	Back Clear

---

**WARNING: ANY changes to these factors will affect the energy vs. channel relationship. If you change these factors, major editing of the isotope radiation lines in the isotope library may be necessary to restore normal operation. Make any changes to either of the factors at your own risk.**

---

The default parameters are:

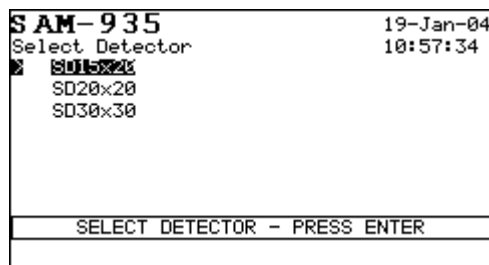
- QCC Offset: 3.0000
- QCC Slope: 60.9996

### 7.9.4. Selecting and Editing Detectors

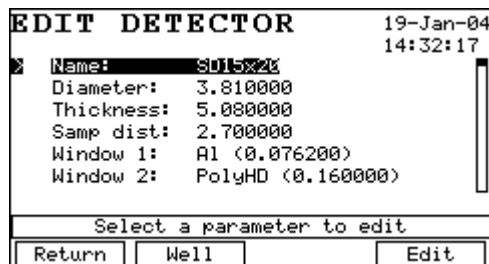
The SAM 935 ships with a factory installed internal or optional external detector.

To review information about the detector:

- Use the up and down arrow keys to highlight *Select/Edit Detector* and press the **Enter** function key.
- The **Utilities**, "Edit Detector Definitions" screen, listing all supported SAM 935 detectors, will open. The SAM 935 uses a theoretical model of the detector installed in your system. The correct parameters for all supported SAM 935 detectors are preloaded in the detector database.
- Use the up and down arrow keys to highlight your detector and press the ENTER function key to select it.
- If your detector size is not found please contact the factory.



- Press the ADD function key (F2) to add a new detector to the database. Press the EDIT (F4) function key to enter new definitions for the "New Detector."
- Press the DELETE function key (F3) to delete the selected detector from the database.
- Press the EDIT function key (F4) to open the **Edit Detector** screen and view the parameters for the selected detector.



Each detector has the following parameters associated with it:

Parameter	Definition and Value
Name	Detector name
Diameter	Diameter (in cm) of the actual NaI crystal
Thickness	Thickness (in cm) of the detector
Samp Distance	Distance from the sample to the detector surface. For well-type detectors, enter zero
Window 1	The material and thickness of the first detector window. For most NaI detectors, the window material is aluminum and the thickness is in cm
Window 2	The thickness of the second detector window, in cm
Window 3	The thickness of the third detector window, in cm. Some detectors have an MgO packing that acts as a window.

**Note:** The F2 function key switches between PLANAR and WELL. Because the SAM 935 does not support well detectors, F2 should always be labelled WELL, which indicates that PLANAR is the current setting.

**Note:** Use of an external detector supplied by a third-party vendor will void the warranty! BNC recommends the use of a semi-rugged detector system with the SAM 935. These systems are available in 1.5 x 2 inch, 2 x 2 inch, and 3 x 3 inch versions. They have internal high voltage power supplies and are resistant to environmental contamination.



## 8. Reports

This section provides examples and explanations of each available report option.

### 8.1. *Downloading Reports with BNC SAUce*

#### Using BNC Sauce:

Connect the SAM to a PC using a null modem RS232 cable. Use Start/Program to find and open BNC Sauce on your PC. In the upper left corner of the screen open the com port. To review stored alarms in the SAM press left arrow. This will review stored alarms starting with the last alarm (right arrow will start with the first alarm). Press F3 (Prn Sel) to transfer the Real Time reports to the PC. Press MCA (F4) and ID (F4). This generates the analysis report that can be transferred to the PC by pressing F2 (P-Full) or F3 (P-Short). BNC Sauce saves all reports and can be accessed by "Open Rich Text" under the Tools menu.

#### Using Autoload:

The Autoload application allows spectra to be downloaded for Quantum software analysis. Place the SAM in Remote (UTIL/SysTools (F2) – ENTER second item down). Open HWSsuper on the PC to perform hardware search and establish communication. Check the box on Serial Port, PGT/ANS COM, Quantum COM and click Update. After communication has been verified close HWSsuper. Open Autoload and establish a file for spectra before downloading alarms. At the completion of download, files can be opened with Quantum NaI. Consult Quantum manual for further details.

### 8.2. *Real Time Report of Alarms*

The real time report lists dose rate information about alarms.

To generate the real time report:

Press the PRN SEL function key (F3) while in alarm review mode. Only the currently displayed stored alarm will be printed.

#### Real Time Report

```
Alarm # 5 at 01-Jun-2005 13:41:21 for 60 sec (captured) SAM Serial #: 90521
Nuclide(s)      Peak Conf  Total Conf  Peak Dose      Avg Dose
Full            36.38      36.08      10.50 urem/hr  10.50 urem/hr
Unid Pk         9.09       9.05       0.00 nrem/hr   0.00 nrem/hr
Cs137           1.89       1.84       50.60 nrem/hr  49.32 nrem/hr
The following monitors had no measured activity:
Co60 K40
Gamma counts/sec: 235.78
```

### 8.3. MCA Report

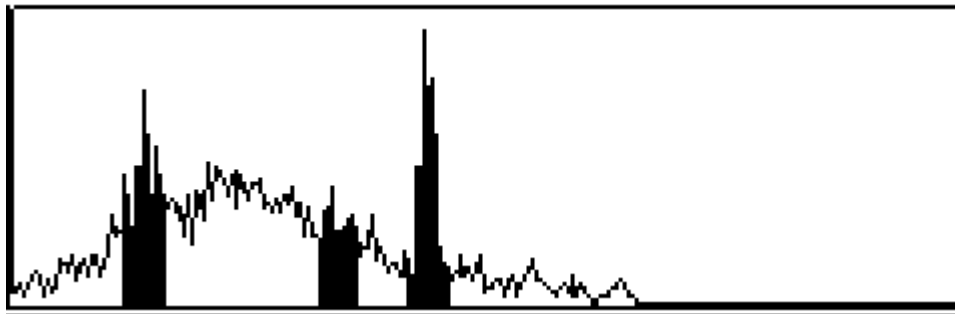
The MCA report can be generated in either a short (no spectra) or full (spectra) format. This report will provide qualitative analysis data, as well as ROI and photon intensity matched isotope identification. If you subtract the UNC % number from 100 you will get the confidence level of identification.

**Remember:** The only isotopes that will be included in the analysis are those that have an <ENA> (enabled) in the master isotope library.

#### MCA REPORT

DATE:	11-Apr-2005 06:19	SAVED AS: Spectrum # 2	
EN CAL DATE:	11-Apr-2005 06:17	BIAS:	904
		COARSE GAIN:	1
		FINE GAIN:	1.39
BKG DATE:	11-Apr-2005 06:18	LOW DISC:	0.41%
GROSS CPM:	214555	HIGH DISC:	100.05%
NET CPM:	211482	ELAPSED LT:	1.08
GROSS INTEGRAL:	3862	ELAPSED RT:	1.12
NET INTEGRAL:	3806	DEAD TIME:	3.57%

FULL SCALE: 101



#### PEAKS FOUND

CHN	ENERGY (keV)	GROSS CPM	AMBIENT CPM	CONTINUUM CPM	NET CPM	UNC %	
36	97.7	29388	666	18611	10111 ± 12.6		
88	430.9	18388	111	11888	6388 ± 15.8		
111	660.7	26833	55	7944	18833 ± 6.48		Cs137

1 OF 1 LIBRARY LINES FOR Cs137 FOUND	Correlation =	0.80
LINE PEAK INTENSITY NET CPM		
661.7 660.6 90.00 18833		

#### NUCLIDES NOT PRESENT:

0 OF 1 LIBRARY LINES FOR Am241 FOUND	Correlation =	0.00
0 OF 2 LIBRARY LINES FOR Co60 FOUND	Correlation =	0.00
0 OF 7 LIBRARY LINES FOR Eu152 FOUND	Correlation =	0.00
0 OF 1 LIBRARY LINES FOR K40 FOUND	Correlation =	0.00
0 OF 1 LIBRARY LINES FOR U238 FOUND	Correlation =	0.00

### 8.4. Energy Calibration Report

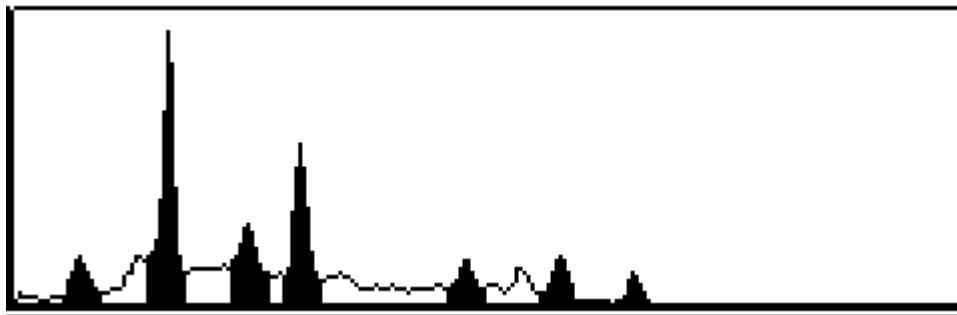
The energy calibration report is generated when a multi-line standard is measured to generate a quadratic energy calibration for the system.

The calibration report provides the name of the standard used, the dates and times of all acquisitions, the system hardware parameters, the calculated and standard energies and the current energy and calibration coefficients.

# ENERGY CALIBRATION REPORT

STANDARD:	Eu152	BIAS:	971
DATE:	19-May-2005 14:26	COARSE GAIN:	1
EN CAL DATE:	19-May-2005 14:31	FINE GAIN:	1.47
BKG DATE:	19-May-2005 14:24	LOW DISC:	0.41%
GROSS CPS:	1085	HIGH DISC:	100.05%
NET CPS:	926	ELAPSED LT:	300.00
GROSS INTEGRAL:	325502	ELAPSED RT:	302.84
NET INTEGRAL:	277877	DEAD TIME:	0.94%

FULL SCALE: 13657



## CALIBRATION POINTS

CHN	ENERGY		ERROR
	CALIB	STANDARD	
18	38.7	41.0	-2.3
42	123.2	121.8	1.4
63	245.0	244.7	0.3
78	346.4	344.3	2.1
122	776.9	778.9	-2.0
147	1101.0	1101.0	-0.0
167	1408.5	1408.0	0.5

CAL ISOTOPES: Eu152

## CALIBRATION COEFFICIENTS

ENERGY:

C(0)	-2.9593e+000
C(1)	9.9124e-001
C(2)	2.3279e-005

## 9. Specifications

### 9.1. *Features*

#### **Functions**

Nuclide identification, spectrum analysis, dose rate (rem/Sv) calculation, total dose display, source finding.

#### **Integrated Electronics**

Digital Multi-Channel-Analyzer, spectroscopy amplifier, power supply

#### **Internal Gamma Detector (if present)**

1.5" x 2" NaI detector with integral HV supply

HV control from 0 - 1200 V, but actual operating voltage is determined by the detector characteristics

#### **Internal Neutron Detector (if present)**

He - 3 proportional detector with polyethylene (UHMW) moderator

Gas Volume: 10.4 cc

Gas Pressure 20 atm

Integral HV supply and shaping amplifier

Integral upper and lower level discriminators and logic output for Neutron recognition

#### **External Gamma Detector (if present)**

1" x 1" NaI detector with integral HV supply

2" x 2" NaI detector with integral HV supply

3" x 3" NaI detector with integral HV supply

Custom sized NaI detectors available

### 9.2. *Physical Dimensions*

**Weight:** 5 ¼ lbs. with ø 1" x 2" NaI and batteries

**Dimensions:** 12" W x 8 5/8" H x 2" D

**Protection:** Water resistant & dust tight

### 9.3. *System Specifications*

#### **Energy Range**

18 KeV - 3 MeV

#### **Amplifier**

Type: Pseudo-Gaussian

Shaping: Bipolar

Coarse Gain: 1x, 2x, 4x, 8x

Fine Gain: 1.000 to 2.550 in steps of approximately 0.0006

## **ADC**

Type: Base Converter 14-bit Successive Approximation  
Conversion Modes: Linear - 256, 512, 1024 Channels  
QCC - 256, 512 Channels (U.S. Patent 5,608,222)  
LLD: 0 to 105% of full scale digitally adjustable in .1% intervals  
ULD: 0 to 105% of full scale digitally adjustable in .1% intervals  
Zero: -5 % to + 5% of full scale, digitally adjustable

## **9.4.      *Special Features***

### **Patented Technology**

Quadratic Compression Conversion (QCC) allows for identification of mixed isotopes in one second.  
Provides 97% ID confidence level in 2 seconds.

### **Trigger Lists**

Multiple trigger lists for different field applications (Counter-Terrorism, Environmental, Medical)

### **Customizability**

Modifications of isotopes and their associated energy lines can be added, deleted, or changed in the field with no computer needed.  
128 Customizable Isotopes in the library  
400 Customizable Energy Lines

### **Ease of use**

Password Lockout Mode for non-technical personnel  
Hands-free operation

### **Calibration**

Automatic Coarse Calibration  
Fine Energy Calibration  
Dose Rate Calibration

## **9.5.      *Controller***

**Display:** 240 X 128 high contrast black-and-white FSTN graphics with CCFL backlight  
Monochrome LCD, 10 1/2x 5 1/2 cm  
**I/O:** DB9M RS-232 port for printer or computer connection  
**Clock:** Battery-backed-up clock/calendar  
**Controls:** 10-key custom keypad utilizing software programmable function keys  
**Alarm:** Audio/visual – separate LED for Gamma and Neutron

## **9.6.      *Batteries and Accessories***

### **Power**

Power: NiMH; Internal battery pack; external factory-supplied dual mode supply/charger, 12w; Continuous 110V Operation available; 8 hour battery life.

### 9.7. Accessories

External battery charger, AC car adapter, Pelican rugged case, Quantitative Analysis Software, Tantalum Shield, Check Sources, Ethernet adapter, Earphone adapter.

### 9.8. Example Isotopes for Inclusion in SAM 935 Trigger Lists

Trigger List (A) Industrial Isotopes	Trigger List (B) Medical Isotopes	Trigger List (C) Special Nuclear Materials
<b>Ra-226</b> Radium 226 NORM	<b>Tl-201</b> Thallium 201	<b>U-235</b> Uranium 235 (Highly Enriched Uranium)
<b>Th-232</b> Thorium 232 NORM	<b>I-131</b> Iodine 131	<b>U-233</b> Uranium 233
<b>K-40</b> Potassium 40 NORM	<b>Technecium 99</b> (metastable)	<b>Pu-239</b> Plutonium 239
<b>U-238</b> Natural/Depleted Uranium – NORM	<b>Ga-67</b> Gallium 67	
<b>Am-241</b> Americium 241	<b>In-111</b> Indium 111	
<b>Cs-137</b> Cesium 137	<b>Xe-133</b> Xenon 133	
<b>Co-57</b> Cobalt 57		
<b>Co-60</b> Cobalt 60		
<b>Ba-133</b> Barium 133		

## Appendix: Manual Operating Mode

Use Manual mode to:

- Acquire data.
- View and edit hardware parameters.
- Set, clear, and edit regions of interest (ROIs).
- Perform qualitative analysis.

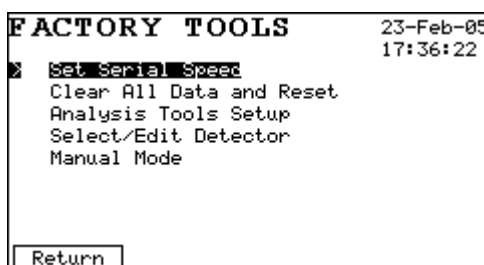
---

*Note: An MCA display screen similar to Manual Operating Mode with limited functionality can be accessed while reviewing an alarm.*

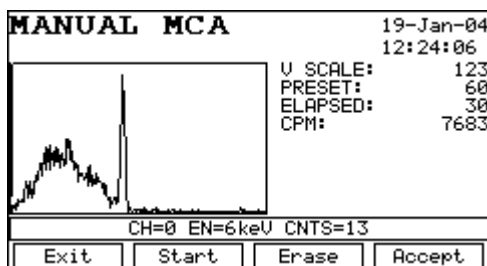
---

To operate in Manual mode:

- Press the UTIL function key, System Tools, then Factory Tools Setup, and use the up and down arrow keys to highlight *Manual Mode*.



- Press the ENTER function key to open the **Manual MCA** screen.

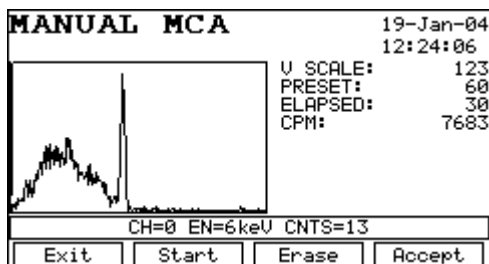


While in Manual operating mode, you can press the UTIL key to display different sets of function keys, as indicated in the message line, "Use UTIL to toggle functions."

- Press the EXIT (F1) function key to stop acquisition without saving data and leave Manual mode.
- Press the START (F2) function key to start data acquisition. When collection starts, the label will change to STOP. You can start and stop data acquisition as many times as necessary. When a spectrum is displayed, the message line will display the cursor readout, the cursor channel (CH), the energy (EN, if calibrated) and the counts in the cursor channel (CNTS).
- Press the ERASE (F3) function key at any time to erase the data and reset the elapsed real and live times to zero. **Note that no warning message is given indicating that data is about to be erased.**

To display and edit the results:

- Press the ACCEPT (F4) function key to perform an analysis of the presently displayed MCA data. This should normally result in a report screen that can be scrolled down using the arrow keys to view the remaining text. This report can be sent to a printer if one is connected. A PC can be used to receive the text if a Windows Text terminal program such as HyperTerminal is running, although only the short report (F3 – P-Short) should be used. By receiving the text on the PC, the Windows printer can be used or the text captured to a file on the PC's hard disk.



---

***WARNING: To perform a new analysis, the ROI set from the previous analysis must be manually cleared to force a fresh peak search. Failure to clear the previous ROI set will result in an analysis based on peak search ROIs from the previous spectral data set.***

---

- Press the RETURN (F1) function key to exit the report screen back to the MCA screen.
- Press the P-FULL (F2) function key to print a report including the spectral data display to a graphics printer.
- Press the P-SHORT (F3) function key to print a report including the spectral data display to a text printer or computer terminal program.
- Press the SAVE (F4) function key to save the current spectrum to non-volatile RAM (NVR) memory for later transfer to the PC via the AutoLoad.exe program. Note that a spectrum saved at this time cannot be viewed as an alarm by the SAM 935 firmware. However, use of the Capture key from the main monitoring screen does provide the ability to view the spectrum later.

The long version of the report includes:

- System setup information
- A graphical printout of the spectrum
- Detailed peak analysis
- Details of the isotope cross correlation analysis

See Section 8.3 for an example of the report.

The short version of the report includes:

- System setup information
- Detailed peak analysis

---

***Note: If the printer does not support the graphics command set used by the SAM firmware, or the report is being sent to a PC running a text only terminal program (such as HyperTerminal), use only the short version of the report.***

---



## A.1 MCA Presets

The SAM 935 has the following types of preset controls:

Preset Control	Description
ON/OFF	When set to OFF, presets will have no effect. Same as setting all presets to zero.
LT Pre	Preset live time. Exact value.
RT Pre	Preset real time. Exact value.
Pk Pre	Preset peak count. Value may slightly exceed the preset.
Int Pre	Preset integral. Value may slightly exceed the preset.

---

*Note: Use only one type of preset.*

---

## A.2 Manual Hardware Adjustments

When HW ADJ/HW INFO is selected from the Presets screen, a set of hardware parameters is listed in the data window and the F4 function key becomes a DATA key that returns the system to the data mode.

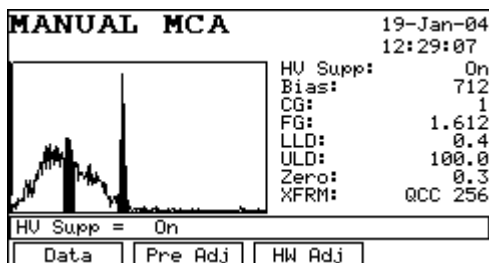
You can adjust these hardware parameters when in Manual MCA mode (HW ADJ). Use the up and down arrow keys to select the parameter, and the right or left arrow keys to change the setting. Changes are applied immediately.

---

***WARNING: Manually changing MCA parameters will invalidate the current system calibration.***

---

You can only view them in other screen modes (HW INFO).



The SAM 935 has the following hardware parameters:

Hardware Parameter	Description
HV Supp	Displays the state of the bias voltage supply (ON or OFF).
BIAS	Current bias voltage setting, ranging from 200 to 1000 volts.
CG	Amplifier coarse gain. Available values are 1, 2, 4, and 8.
FG	Amplifier fine gain, ranging from 1.00 to 2.55 in steps of 0.01.
LLD	Low level discriminator, ranging from 0 to 105 percent of full scale in steps of approximately 0.4%. For normal work, the LLD should be set to 0.4%.
ULD	Upper level discriminator, ranging from 0 to 105 percent of full scale in steps of approximately 0.4%. For normal work, the ULD should be set to 105%.
ZERO	ADC zero setting. Range is $\pm 5\%$ of full scale.
XFRM	Conversion mode. The system is optimized for QCC (SQRT) mode and it is required that you perform all analyses in this mode. Standard linear mode is available only for remote mode under control of Quantum software.

- Press the UTIL key to step to the next function key set.

### **A.3 Additional Manual Mode Function Keys**

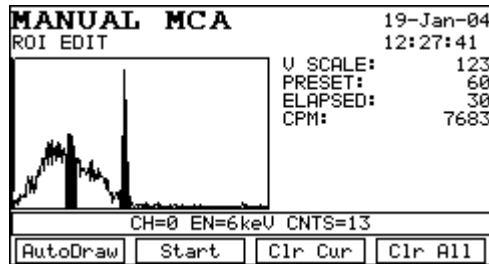
- Press the DATA (F1) function key to display dynamic data during Acquire.
- Press the PRE ADJ (F2) function key to display or edit the Preset parameters.
- Press the HW ADJ (F3) function key to display or edit the MCA Setup parameters.
- Press the UTIL key to step to the next function key set.
- Press the WIDE (F1) function key to change the spectral data window to fill the screen. Note that the label for the F1 function key changes to NORMAL. Press the key again to change the window back to Normal mode.
- Press the LOG (F2) function key to change the vertical display method to LOG mode. Note that the label for the F2 function key changes to LINEAR. Press the key again to change the vertical scale back to Linear display mode.
- Press the STRIP (F3) function key to change the spectral data window to include the background subtraction data. Note that the label for the F3 function key changes to RAW. Press the key again to change the data content back to Normal display mode.

---

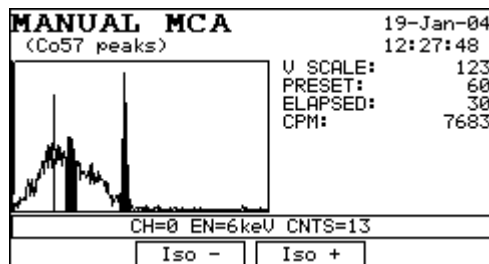
***WARNING: To perform a new analysis, the ROI set from the previous analysis must be manually cleared to force a fresh peak search. Failure to clear the previous ROI set will result in an analysis based on peak search ROIs from the previous spectral data set.***

---

- Press the UTIL function key again to activate the ROI editing keys shown in the **Manual MCA**, "ROI Edit" screen. This does not work in Background mode, where there are no ROIs.



- Use the AUTODRAW (F1) function key to create a standard width ROI centered around the pointer location. Use the arrow keys to position the pointer in the desired location and press F1.
- Use the START (F2) function key to set the left boundary of an ROI. Use the up and down arrow keys to position the pointer at the appropriate starting channel. Press START. The START key will change to STOP. Use the left and right arrow keys to define the ROI. After you set the end channel, press the STOP key. You can set as many ROIs as you want, but note that ROIs cannot overlap as they can in Remote Mode using Quantum software. If you set a new ROI over an existing one, the overlapped portion of the old ROI will be replaced with the new one.
- Press the CLR CUR (F3) function key to remove the current ROI (the one in which the pointer is located).
- Press the CLR ALL (F4) function key to remove all ROIs. This step is required if a new analysis is to use a fresh peak screen.
- Press the UTIL function key to open the library peak labeling function.



The library peak labeling function lets you display the gamma lines associated with particular nuclides superimposed on the current spectrum. This feature is available both during and at the end of data acquisition. The Iso - (F2) and Iso + (F3) keys cycle through the list of all enabled nuclides in the nuclide database. The enabled lines are shown with a height proportional to the log of their intensity.

---

**WARNING: The hardware controls, preset controls and ROI controls are only functional in Manual MCA mode. These controls are not functional while reviewing an alarm.**

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